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REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., September 12, 1923.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1923.

Respectfully,

E. W. NELSON,
Chief of Bureau.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

ORGANIZATION OF THE BUREAU.

In order to conduct the necessary investigations relating to our wild birds and mammals and to promote the conservation of the useful and harmless species and to destroy those that are harmful, the Biological Survey is organized under the following divisions:

1. Economic Investigations, Dr. A. K. Fisher in charge. Develops methods of control and cooperates in campaigns for the destruction of predatory animals and injurious rodents. Has supervision also of an experimental fur farm and cooperates in fostering the fur-farming industry and in the conservation of fur-bearing animals.

2. Food Habits Research, W. L. McAtee in charge. Investigates the food habits and economic relations of birds, reptiles, and amphibians. Makes studies of the food resources of water areas for migratory wild fowl, to improve production, and devises practical methods of control for injurious birds.

3. Biological Investigations, E. A. Goldman in charge. Investigates the distribution, migration, and other habits of wild birds and mammals and the distribution of wild plant and animal life in relation to climate for the purpose of mapping the life zones of North America. Makes technical laboratory and field studies of birds and mammals. The scientific results of the work of this division form the basis for the increasing economic activities of the bureau.

4. Alaska Reindeer and Fur Bearers, E. W. Nelson and W. F. Bancroft in charge. Investigates diseases and parasites of reindeer and studies forage plants, grazing areas, herd management, and other problems relating to the upbuilding of the reindeer industry. Administers the law protecting Alaskan land fur animals and makes investigations to assist in developing fur farming in the Territory.

5. Game and Bird Refuges, Smith Riley in charge. Supervises the maintenance of Federal big-game and bird refuges and the warden service on them, and the production of hay and feeding of elk on the winter Elk Refuge.

6. Migratory-bird Treaty and Lacey Acts, G. A. Lawyer in charge. Administers the laws for the protection of migratory game and other birds, for the prevention of illegal interstate shipments of game, and for the prevention of the importation of harmful species of wild birds and animals.

ECONOMIC INVESTIGATIONS.

WILD ANIMAL PESTS.

The national forests and other great areas of public lands in the Western States are the main breeding places of wolves, coyotes, mountain lions, and other stock-killing animals, and of prairie dogs, ground squirrels, pocket gophers, and many other forage and crop destroying rodents. For the purpose of reducing losses in livestock and forage on the public domain and to cooperate with the States, local organizations, and individuals in campaigns for the destruction of these wild animal pests on State and private lands an appropriation of $440,121 was made available by Congress for the year, of which $276,890 was used for the destruction of predatory animals and $163,231 for work in rodent control. Twelve of the public-land States made direct appropriations of cooperative funds to use with the bureau for this fiscal year. Furthermore, seven additional States provided cooperative funds without direct appropriations, which made a total of $844,000. Of this, approximately $243,000 was for the destruction of predatory animals and more than $601,000 for the rodent campaigns. From the beginning of this work the survey has maintained that eventually it would be practicable completely to destroy some of the worst of these animal pests and thus forever eliminate the heavy losses they have been causing. Through the campaigns against them prairie dogs have been exterminated on considerable areas, and the large wolves, of which 4,900 have been killed, are being so reduced in numbers that over most if not all of the West their end is in sight.

The best evidence of the growing appreciation of the practical value of campaigns against animal pests in the West was given in the winter of 1923 by the legislatures of 13 States, which made total appropriations of about $647,000 for cooperation in the work during the following biennium.

The results obtained in the campaigns against animal pests have been possible only through the hearty cooperation of States, local organizations, and individuals. In addition to funds contributed more than 104,000 farmers and stockmen took an active personal part in the rodent field work. Good progress was made at the Denver laboratory in working out poison combinations to increase the effectiveness of the field operations. Application has been made for a patent in favor of the Department of Agriculture to cover a new poison combination that in field tests has given remarkable results with both predatory animals and rodents.

PREDATORY ANIMALS.

Organized field operations against predatory animals were in progress during the year in Arizona, Arkansas, California, Colorado, Idaho, Michigan, Montana, Nevada, New Mexico, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. Requests for assistance have also been received from Louisiana, Wisconsin, Minnesota, North Dakota, and Indiana. As a result of demonstrations given in Missouri the State legislature appropriated $15,000 for cooperation with the bureau in the destruction of predatory animals through the State Board of Agriculture and also provided that in further cooperation the State game department might expend funds at its disposal. South Dakota for the first time provided a cooperative fund of $30,000 for use during the ensuing biennium.

In connection with its work on the national forests and other Federal lands, the bureau has enlisted the cooperation of other Federal, State, and private agencies in order to correlate all efforts in an effective drive for the destruction of predatory animals on Federal, State, and private lands, thus giving general protection to livestock. State agencies taking part have included departments of agriculture, livestock commissions or boards, game commissions, extension departments of the States, county organizations, stockmen's associations, and individuals. Cooperation with other Federal agencies which control areas of Federal lands included the Forest Service of the Department of Agriculture, the Office of Indian Affairs, and the National Park Service of the Department of the Interior. The Bureau of Plant Industry and the Bureau of Chemistry, of the Department of Agriculture, have rendered important assistance in connection with laboratory investigations.

Improved poison combinations and their systematic distribution have been so successful that poisoning is rapidly superseding other methods of predatory-animal control. The great increase in territory that can be covered by poisoning campaigns, as now conducted, for the first time offers a possibility of eliminating coyotes over vast areas. This has hitherto appeared doubtful, owing to the numbers and wide distribution of these pests. More than 200,000 square miles were covered by organized poisoning operations during the year, and at carefully established poison stations on this area more than 1,703,000 specially prepared poison baits were distributed.

Present methods in poisoning operations are the result of gradual development and are based on both laboratory and field investigations. From the beginning it has been recognized that the development of an effective poisoning procedure would be essential to the ultimate handling of the coyote problem. The results now being obtained surpass even the expectations at the beginning of the experiments.

Inspectors and field assistants have given special attention to cooperative work with stockmen's associations, which employ men to establish poison stations and distribute the baits in accordance with demonstrations and directions given them. Stockmen and their ranch foremen have also been trained in modern poisoning and trapping methods and have participated more extensively than ever before in the actual work.

During the year an average force of 250 hunters, trappers, and poisoners was employed under bureau supervision, in addition to the thousands of stockmen who personally took part in the work. Part of the men employed were paid from Federal funds and part by the States and other cooperating agencies. During the year hunters took the skins or scalps of more than 29,300 predatory animals, of which 599 were wolves, 447 of these being the large gray wolves; 25,622 coyotes; 2,822 bobcats and Canada lynxes; 158 mountain lions; and 101 bears. Bears are regarded as game animals and no effort is made to take them, except individuals known to be destructive to livestock.

In view of the substitution of poisoning campaigns for other methods of field operations in most of the districts during six to nine months of the year, the number of skins and scalps taken is no longer a satisfactory gauge of the number of animals killed. Men spend practically their entire time in establishing poison stations and distributing baits, and relatively little time in searching for animals killed, as the value of the skin commonly does not pay for the time lost. One man in the Lemhi National Forest, Idaho, by use of an automobile maintained a poison line 700 miles in extent, which served to cover an area of about 5,000 square miles. This method of procedure has been strongly urged by stockmen, who, convinced of the effectiveness of the poisoning operations, are more concerned to have the poison distributed carefully on a large scale than to have hunters spend time searching for animals killed. The carcasses are usually found later by the stockmen.

From 5 to 15 dead coyotes are commonly found near a single poison station, and one stockman reported having seen 22. In one day one of the demonstrators put out a poison line 35 miles long, and, returning along it the following morning, saw from his automobile 14 dead coyotes. Another hunter, who put out 400 baits in the vicinity of several reservoirs, later found 57 dead coyotes, and a stockman reported finding 60 more coyotes that had been killed but had not been found and scalped by the hunter. The manager of a large ranch in Texas, on which about 12,400 baits were used, reported that at least 1,000 coyotes were killed. Previous to poisoning, a trapper on this range was able to take from 60 to 70 coyotes per month, but after poisoning the best a skilled trapper could do was to take 10 to 12 per month.

Complete returns of predatory animals killed in the United States in poisoning campaigns can not be obtained, but the sudden marked reduction in the numbers of coyotes over great areas and the number of carcasses subsequently found by stockmen on their ranges and by hunters about poison stations where it has been possible to make careful observation, indicate the strong probability that not less than 75,000 coyotes were killed by the poisoning operations; the carcasses of these were not found, however, in time to be recorded. Many wolves, bobcats, and a few mountain lions also were poisoned. On the generally accepted basis of calculation the killing of these predatory animals with those of which the skins and scalps were secured represents an annual saving in livestock and game of more than $5,979,000. Skins sold during this year yielded $34,839 to the Federal Government and $39,668 to cooperating States and stockmen's associations.

Poisoning operations are conducted chiefly from October to April, but effective work was done even in summer, especially about watering places in the drier areas used for winter grazing. When practicable the major poisoning operations are carried on at times when livestock is not present, poisoning on high summer ranges being done just after the stock goes to lower levels in fall. Poison stations are placed systematically over the range, especially in occupied territory. The advantage of systematic placing is that, in addition to the effectiveness of killing, warning notices can be posted so that valuable dogs or other animals may be protected. In addition, poisoned baits not taken by predatory animals can be picked up and destroyed or used elsewhere.

Such systematic work on summer and winter ranges and on lambing grounds has practically ended livestock losses over large areas. The destruction of predatory animals has been sufficient to enable many stockmen to reduce the number of men required to care for their flocks and herds. Some stockmen now report carrying their flocks through the lambing period with no loss whatever from coyotes, where previously losses were heavy. An important feature of this service is that it not only permits the stockmen to handle their herds at less expense but it also enables them to utilize the pasturage much more fully; to manage their stock to better advantage by eliminating long drives to bedding grounds; and to adopt the advantageous open-herding system. The destruction of predatory animals has also in some places permitted sheep raising to be introduced where formerly it was excluded on account of the losses inflicted by predatory animals.

Clearing the ranges of coyotes is proving a boon to the cattlemen as well as to the sheepmen, for with the practical elimination of the gray or timber wolf over much of the range country of the Western States, cattlemen have discovered that heavy losses of calves heretofore attributed to wolves have evidently been due to coyotes.

In the campaign which has been waged for the destruction of timber wolves, most gratifying results have been obtained. An effective patrol maintained along the border of Mexico has resulted in the killing of many animals which were crossing from Mexican territory into the ranges of Texas, New Mexico, and Arizona. Persistent work with poison and traps has so reduced the number of adult timber wolves that it probably does not exceed 10 to 50 adult animals in any of the various Western States. The ranges of practically all the wolves which have proved destructive to livestock are well known, and good headway has been made in clearing out these remnants. In many sections these animals have become so scarce that they are luring domestic dogs away as mates, and in a few instances are known to have produced litters of hybrid young.

A number of notoriously destructive individuals and even small packs of wolves have been destroyed during the past year. Among them the following may be cited:

In response to a telegram from stockmen ranging cattle near Thatcher, Colo., a hunter was detailed to take a wolf believed to be the leader of a pack depredating in the locality. Work against the wolves there had been in progress at intervals during the past five years, and inquiry established the fact that during the course

of six weeks 20 head of cattle were killed and the tails were bitten off a number of small calves. The hunter succeeded in trapping an old male wolf, with the result that depredations were entirely stopped in the vicinity, and evidence showed that only a lone she wolf still remained in that area. This female mated with a collie dog, and in efforts to get her, the collie was killed by poison and later she was taken in a trap. The stockman, on whose ranch the wolf was killed, writes as follows:

Old Three-Toes, as this particular wolf was called, was caught in one of the Government traps especially constructed for wolves, and the hunter has caught two of her pups. With her capture ends the pack of which she was leader. Thousands of dollars worth of calves and sheep have been killed by this wolf and her pack. Just a few days prior to her capture, Old Three-Toes killed six calves here on our ranch, 11 miles west of Thatcher. We hold a private grudge against this old gray wolf, as she mated with our pet collie dog, even going so far as to dig him out of a pen. He heard the "call of the wild" and answered it, going off for days at a time, sometimes coming home for a few days. At last he went away for weeks and was finally poisoned by one of your men. This was a good thing, as a collie, hearing the "call of the wild," kills for his young, too. We extend our thanks for staying on the job and getting Old Three-Toes and her pack. Other stockmen join us in our praise of you and your men, as the loss from predatory animals has been reduced to almost nothing.

A stockman in Arkansas makes the following statement regarding work accomplished in his locality:

Your hunter accomplished here what all others failed to do. These wolves have been hunted persistently for years, consequently had become very shrewd and cunning. I am one of the hunters of this locality myself, so realize what skill was required to capture such cunning animals. We have used every method we could think of against these wolves, but failed to do more than reduce them to some of the most cunning and destructive ones. We have used poison and traps and resorted to wolf drives, but still they stayed with us, taking an annual toll of thousands of dollars worth of calves, pigs, sheep, and goats. The second wolf your hunter captured was a notorious old male. I have known this wolf for the past five or six years and am quite positive that he participated in the killing of two large calves for me the past spring, as well as hundreds of pigs. It has been next to impossible for us to raise any hogs at all in this section. This particular wolf was an exceptionally large, cunning old fellow, having killed thousands of dollars worth of livestock for the stockmen of this county.

Another stockman reports that he missed a pig one morning and when the hunter ran his trap line that day he brought in a wolf with parts of the pig in her stomach.

PREDATORY ANIMAL WORK IN MICHIGAN.

Depredations of wolves on deer in northern Michigan became so serious in 1921 that at the request of the conservation commission of that State one of the most experienced and competent wolf hunters of the bureau was detailed to Michigan for the purpose of training wardens to destroy these pests. Bounties on wolves, coyotes, weasels, woodchucks, crows, hawks, and owls, amounting to more than $312,000, were paid during the fiscal year ended June 30, 1921. All bounty payments have now been discontinued. The present plan of conducting systematic trapping and poisoning campaigns through warden-hunters, trained by our experienced man, as mentioned above, is costing the State $35,000 annually, the expense being borne by funds derived from hunting licenses. The work has been so effective that in some sections wolves have entirely disappeared and elsewhere are being rapidly reduced in numbers.

NEW LURE FOR MOUNTAIN LIONS.

One of the important developments of the year has been the introduction of oil of catnip as a lure in trapping and poisoning mountain lions and bobcats. Heretofore the taking of mountain lions has been exceedingly arduous work because of the rough and inaccessible country which they frequent and the fact that it has been necessary chiefly to trail them with dogs and to shoot them when treed or driven into caves. A representative of the Biological Survey had ascertained that mountain lions and bobcats were attracted by the odor of catnip. Effort was made to obtain an extract of this plant or a synthetic product which would carry the attractive odor in a form sufficiently permanent for use in field operations. Oil of catnip was not produced on a commercial scale and the Bureau of Chemistry advised that only very minute quantities had ever been extracted in connection with laboratory experiments.

The securing of a supply of oil of catnip for the desired purpose is a most interesting case of effective cooperation. From the Drug Investigations Division of the Bureau of Plant Industry the Biological Survey in 1920 obtained a very small quantity, sufficient to determine that the oil carried the characteristic odor and that this would persist for several months when exposed in the open air. A small area was planted to catnip by the Bureau of Plant Industry on the Arlington Experimental Farm, from which enough was produced to extract sufficient catnip oil for a thorough test in field operations. It was found that the oil of catnip could be diluted with oil of petrolatum and still retain the characteristic odor. This permitted a more extensive use of the limited supply, and through it several mountain lions and large numbers of bobcats have been lured into traps or to take poisoned baits. The odor of catnip appears to exert an almost unfailing attraction for these animals and other members of the cat family. Discovery of this use of the material is an important contribution to the methods of taking these destructive animals.

PREDATORY ANIMALS AND GAME.

State game departments and sportsmen's associations have cooperated heartily with the bureau in efforts to destroy predatory animals. Timber wolves, coyotes, wild cats, and foxes all join in game destruction, the kill being heaviest in winter when the snow is deep and especially in early spring after the snow becomes crusted. At this period wolves and coyotes often appear to kill for no apparent reason other than amusement or sheer lust of killing. During the spring and summer the losses of young game animals and the destruction of ground-nesting birds, their nests, and young is one of the most serious checks on game increase. In many sections of the West, where operations have been in progress for a sufficient length of time for the reduction of predatory animals to become effective, State game departments report a notable increase in quail, grouse, and deer.

RABIES.

Sporadic outbreaks of rabies have continued to occur in a number of the Western States, but have been kept under control by the prompt concentration of skilled hunters to destroy infected predatory animals and other carriers of the disease.

RODENT PESTS.

Investigations by the Biological Survey during a long period show conclusively that many species of rodents occupying the territory from the Great Plains west of the Mississippi River to the Pacific coast are exceedingly destructive to the most nutritious forage grasses and to crops. Through their excessive numbers they have thus become very serious competitors of livestock on hundreds of millions of acres as well as a heavy drain on the agricultural output. Losses from rodent pests in orchards, vineyards, and truck farms of the Eastern States are also reported to be severe by State officials and by employees of the bureau.

In 1916 it was estimated that the losses through rodents in the Western States amounted to about $300,000,000, of which $150,000,000 was in the destruction of forage and the remainder in the devastation of cultivated crops. This bureau, working in cooperation with State and local agencies, has conducted campaigns against these animals since that time and a large decrease in the losses has resulted.

These campaigns have been organized with a view to correlating all Federal, State, and local agencies into an effective cooperative force so that the work might be so systematically planned and conducted as, one after another, to clear great areas of rodent pests. This work has been backed by a remarkably sustained interest and strong financial support on the part of farmers and stockmen, who recognize the direct and definite benefits from it. The magnitude of the results of the campaigns has been achieved largely through the fine cooperation of the States Relations Service, now the Office of Cooperative Extension Work, with the State extension organizations, including the county agricultural agents, and State and county farm bureaus. State departments of agriculture are taking an increasingly large part in the undertaking through the establishment of pest districts and enforcement of State laws which provide for the clearing of rodent-infested lands on petition of the resident landowners. Many other agricultural, horticultural, and livestock organizations have also taken active part. Officials of the Forest Service, of the Office of Indian Affairs, and of the Reclamation Service continued to cooperate heartily in campaigns involving Federal lands under their control.

Where the strictly economic problems are involved with features relating to community health, as in bubonic and pneumonic plague, Rocky Mountain spotted fever, tularaemia, and kindred diseases disseminated by rodents, the bureau has continued to cooperate with the United States Public Health Service of the Treasury Department and with State, county, and municipal health organizations. Such cooperation is essential to an effective and economical handling of the work when such rodents as house rats and mice infest cities, villages, and the rural sections.

PRAIRIE DOGS AND GROUND SQUIRRELS.

Among rodent pests, one of the most conspicuous and destructive in the area which it inhabits is the prairie dog, but the various species of ground squirrels occupy a vastly larger area and because of their abundance and general distribution cause even heavier losses to farmers and stockmen. Prairie dogs occupy more than 120,000,000 acres of grazing and farming land in 11 States, as follows: Texas, New Mexico, Arizona, Utah, Colorado, Kansas, Nebraska, Wyoming, South Dakota, North Dakota, and Montana. Ground squirrels of the various species infest practically the entire country west of the Mississippi River. These animals cause enormous losses by digging up the planted seeds of farm crops and by cutting down the growing crops throughout the season to harvest time.

Over great areas both prairie dogs and ground squirrels reduce the forage available for livestock by as much as 25 per cent or more. Prairie dogs often completely denude productive lands of all grasses, leaving them to make barren wastes also of new locations where food is more readily available. In many places these bare areas grow up to worthless weeds and require several seasons before desirable forage plants are able to become reestablished. In other cases the top soil is washed away down to the bedrock or to a clay base, leaving more or less permanently waste land.

Not only do prairie dogs and ground squirrels select the more fertile lands, but their competition with livestock is rendered increasingly serious because they select and feed upon the same highly nutritious grasses which are most sought and fed upon by livestock. This not only results in a marked decrease in the numbers of livestock that can be carried on the grazing lands but it prevents complete success in efforts to increase the production of forage through improved range-management practices, such as deferred grazing or grazing rotation. The rodents prevent the normal growth and reestablishment of grasses during the interval that the stock are kept off such ranges, while the more abundant food supply thus made available to them is favorable to their more rapid multiplication, as it is found that their increase is closely correlated with the abundance of food.

In organized campaigns against prairie dogs and ground squirrels 13,673,079 acres of Federal and private lands were given a first treatment with poisoned baits during the year, and follow-up work was done on 12,358,315 acres. This makes a total of 11,093,884 acres of Federal and 97,718,640 acres of State and private lands on which the heavy percentage of these pests have been poisoned since 1916 in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. The bureau assumes the cost of operations on Federal land, although adjacent landowners often contribute the labor required for distribution of the poison and even the grain used as bait, in order that the limited Federal funds may be used to cover the largest possible acreage. State officials provide for work on State lands and farmers and stockmen on their own holdings. Funds contributed by State and county appropriations and those expended by landowners in this cooperative undertaking during the year amounted to $592,812.

Reduced cost of poison supplies made it possible materially to reduce the cost of treating lands. Poisoned grain amounting to 1,323 tons was prepared and distributed under the direction and supervision of bureau representatives and cooperating State and county officials, and 210,682 pounds of carbon bisulphide were used in fumigating burrows to eradicate these rodents completely. Farmers and stockmen numbering more than 104,000 took active part in clearing their lands. Taking into consideration the low prices prevailing on farm crops and range grasses during the year, it is estimated that a saving of more than $8,000,000 was thus effected. The estimated saving in crops and forage since this work was started on a large scale in 1916 totals $68,000,000. As lands are progressively and permanently cleared of these pests the savings effected become permanent additions to their productiveness.

Field operations against these rodents progressed during the year to a point where it appeared practicable to lay plans for three-year campaigns to exterminate the rodents in a systematic manner from great units of land. From 75 to 95 per cent of the animals are usually destroyed by the first poisoning treatment and the new plan of procedure contemplates follow-up applications of poisoned grain and carbon bisulphide or other fumigants to complete the work by the third year. In addition to several counties in western States which are now reported completely cleared of prairie dogs, many others have been cleared to a point where only an occasional prairie dog or ground squirrel can be found. Over enormous areas of farming land the repressive measures employed have made it possible for farmers completely to protect their crops from damage in regions where the loss had been excessively heavy and where in many instances it covered the entire crop.

The work is so organized and conducted as to make available to all farmers and stockmen supplies of poisoned bait at a moderate cost. Arrangements made by the bureau for the cooperative purchase of poisons in large quantities have greatly reduced the cost of these supplies. So far as local conditions make it practicable, field operations are being planned with a view to complete eradication over great areas to eliminate permanently the worst rodent pests. Operations will be extended from cleared areas as centers to prevent reinfestation. The work is being correlated along the borders of adjacent States for the purpose of protecting cleared areas in one State from reinfestation from adjoining lands in another. In regions where rodents are regularly extending their ranges they are attacked along the border of such extensions and pushed back. Western Arizona affords a good example of this kind, where the westward movement of prairie dogs was stopped by clearing an infestation on a front 75 miles long and 10 miles deep. Without this check there was serious danger of their spreading over into millions of acres of new territory.

In some instances county eradication campaigns reached the point where only a few rodents were to be seen, and there was a tendency for landowners to slacken in the work. A number of counties which failed to continue effectively the follow-up work suffered considerable reinfestation and came to a realization of the danger that the rodents might return to their former abundance and destructiveness. The work has been taken up again in earnest with a view to perma-

nent riddance of these destructive animals, and other counties are profiting by this experience. The lack of sufficient Federal funds to poison all Federal lands bordering on treated private holdings is seriously impeding the progress of the cooperative campaigns and this is becoming an increasing source of appeal on the part of landowners who have cleared their holdings and feel that they should be protected from reinfestation from public lands.

POCKET GOPHERS.

Recognition of the damage wrought by pocket gophers in orchards and vineyards and in alfalfa and truck crop fields has brought about an increasing demand for operations against them. Successful completion of campaigns against the prairie dogs and ground squirrels in many counties has served as a stimulus to undertake the more difficult task of destroying pocket gophers. As these are burrowing animals, the damage to plants occurs chiefly underground and is often irreparable before the cause is noted. Knowledge of the actual damage being done by these animals and demonstration that it can be effectively controlled at a reasonable cost has led to extensive field operations against them during the year. Such operations have proved that these pests can be successfully eradicated through the use of various vegetable, grain, alfalfa, or clover baits treated with strychnine and properly placed in the runways, and by the use of traps of special design.

Work against pocket gophers has been undertaken on a considerable scale in Arizona, Colorado, Idaho, Kansas, Nebraska, New Mexico, Oregon, Texas, Utah, and Washington, and considerable demonstration work has been done in a number of other States. In Arizona notable progress has been made in eliminating pocket gophers from the citrus and date orchards, with the result that very few trees have been killed by these animals during the past year in such localities. Practically all orchardists in the citrus belt cooperated in treating their holdings with poisoned sweet potato baits. One orchardist who had lost over $10,000 worth of trees from pocket-gopher damage suffered no losses whatever this year, a result of the effective work done. In California it was found that the pocket gopher had gradually worked its way entirely around to the northern end of the Salton Sea and had made its appearance in the Coachella Valley. This presented a serious danger to the Government date gardens established there. As the pocket-gopher injury to a date palm is well concealed until the tree is permanently injured, it appeared advisable that work be done at once to check the infestation, and steps were taken to that end.

In the mountain parks and pasture ranges throughout the Rocky Mountain region pocket gophers are doing an extensive injury to grazing and hay meadows. The introduction of the promising head-lettuce industry into the mountain valleys of Colorado has made the work of controlling pocket gophers of far greater importance than formerly, and they are now looked upon there as one of the greatest pests.

In seven of the important alfalfa-producing counties of Kansas extensive operations against pocket gophers have been conducted. A test was made on 57,400 acres, and the results proved so satisfac-

tory that plans were laid to continue the work on a still larger scale during the coming year. Many alfalfa fields have been entirely freed of these pests and others have only an occasional animal where formerly there were large numbers. Chief reliance was placed on poisoned vegetable or grain baits, but large numbers of traps also were employed.

In Utah 40,254 acres of highly cultivated land were treated by the owners to destroy pocket gophers. This was undertaken after demonstrations were made and other educational work done to show landowners the proper way to use poison and after arrangements were made for them to obtain the required poison supplies in convenient form. In Sevier County, Utah, an interesting demonstration was made on an 80-acre field in which 78 acres were treated with poison at a total cost for labor and poison of $10. The following spring an examination of the field showed by actual count only 6 live pocket-gopher workings on the 78 acres that were treated, while on the remaining 2 acres which were left untreated as a check plot there were 15 live workings.

In Nebraska 53,870 acres were treated in a pocket-gopher campaign and 26 counties included pocket-gopher work in their farm bureau programs. In Oklahoma 480 pocket gophers were trapped on one 80-acre tract. An Oklahoma cooperator writes of the results accomplished as follows:

> It is hard to estimate the value of the pocket-gopher trapping which was done in my alfalfa fields last spring through increased yield, for the reason that there is not a similar field of alfalfa with which to make comparison, and to compare with last season is not fair because of the difference in growing conditions in the two seasons. From long experience as an alfalfa grower, however, I do believe that there is a sufficient increase in yield fully to justify the work to say nothing of the advantages the elimination of the pocket gopher gives to the harvesting of hay, which alone are worth the cost of exterminating them.

Much interest was shown in the eradication of pocket gophers along irrigation canal banks and in the intensively cultivated irrigated districts. This is due both to the direct damage which they do by feeding on the crops and to their burrows in the banks of the irrigation canals. These burrows frequently cause destructive washouts, entailing a serious loss of water, often at a critical period, and expensive repairs, and at the same time may damage the orchards and crops by flooding. Considerable work of this character has been done during the past year in cooperation with the Reclamation Service of the Department of the Interior and with water users' associations. A notable example of the benefits from work against pocket gophers is on the Elephant Butte Project, in New Mexico and Texas.

In Oregon pocket-gopher work was confined almost entirely to Polk County, where a clean-up campaign was inaugurated. Very general satisfaction is expressed with the results to date by most of the farmers in the district. Some of them report that there are absolutely no pocket gophers left on their land, and most of the others report one or two where there were formerly dozens or even hundreds. To complete the work some of this area still needs to be given a third treatment. To date, first treatment has been completed on 20,770 acres, and of this 18,395 acres have been given a second treatment and 8,800 acres a third. The work will be continued during the fall of 1923 on a larger scale.

Pocket-gopher campaigns in Idaho include work in eight counties, where more than 1,650 quarts of bait were used on about 78,000 acres and considerable trapping was done in connection with the poisoning operations.

JACK RABBITS.

Great fluctuations in numbers characterize the occurrence of jack rabbits throughout their range. Relatively little work against them has been required during the past year. The very extensive poisoning and driving campaigns which were conducted in Idaho, Oregon, and Washington during the fiscal year 1922 resulted in such a marked reduction in their numbers that little damage has been reported since.

In Nevada, where serious damage has been done from time to time and extended poisoning campaigns have been conducted with good effect, it has been reported that jack rabbits were destroyed in large numbers by a disease and that they did relatively little damage. In Utah 334,000 jack rabbits are reported killed as a result of the campaigns which were conducted.

In limited campaigns organized in four counties in Idaho about 6,100 pounds of poisoned bait were used on 51,000 acres, and a few drives were also conducted. In Kansas, Montana, and Texas it is reported that jack rabbits are on the increase, and as considerable damage is being done locally, interest is awakening in the inauguration of control measures. Where these animals occur in large numbers they are capable of doing serious damage to growing crops, range grasses, meadows, hay in stacks, and to orchards and vineyards, but methods for destroying them on a large scale have been found.

MEADOW MICE, PINE MICE, POCKET MICE, AND KANGAROO RATS.

Under favorable conditions the various kinds of native mice become excessively abundant locally, and, although small in size, collectively they do serious damage in orchards, gardens, and truck farms. During the previous year meadow mice appeared in destructive numbers in many of the important orchard sections of Idaho and Washington. Where these were foreseen in time the use of poisons recommended by the bureau prevented serious damage, but in many localities where such action was not taken the loss in trees was heavy. This situation emphasized the importance of foresight in dealing with local outbreaks of these small rodents.

During this year such outbreaks of orchard mice occurred in Yakima, Chelan, Okanogan, Grant, Douglas, and Kittitas Counties, in Washington, and necessitated control measures. A questionnaire sent to orchardists showed that in Yakima County 292 growers reported 4,598 trees girdled during the previous winter. In Chelan County a loss of 900 trees was reported. As the trees are from 1 to 15 years old, and valued at from $5 to $100 each, the importance of controlling the mice is evident. A general poisoning campaign was started the 1st of November, which is a very favorable time. Steamed-rolled oats proved a most satisfactory carrier of the poison. In this campaign 19,600 acres of orchard land were treated by more than 1,400 cooperators.

Based on reports received from orchardists, it is estimated that not less than $100,000 worth of trees were saved in the Yakima Valley as a result of these poisoning operations and that the combined savings for all counties would amount to not less than $250,000. One grower stated that he had "55 trees damaged before poisoning; none after poisoning; all damage stopped; value to me, $500." Another grower writes: "Poisoned as near 100 per cent as possible; believe every tree in my orchard (4,800) would have been killed." These statements are typical of many received from other orchardists. Trees once girdled have relatively little chance of complete recovery. Bridge grafting may save a good percentage, but the fruit is usually lost for a period of two years and the trees weakened to such an extent that often they blow over. The injured parts also afford harborage for insect pests, particularly the woolly aphis.

In Idaho, field mice were not very numerous during the past year and did damage in only a few communities. Poisoning operations were conducted in Ada County, where 480 acres of orchard were treated, 600 quarts of poisoned bait being used.

Pine mice continued to do much injury in orchards when the ground was covered with snow, and considerable loss of potatoes, sweet potatoes, and other root or tuber crops and flower bulbs was reported. The experiments conducted resulted in developing a much more effective poison preparation and in devising a simple and relatively inexpensive method of distribution. Very satisfactory protection was thus given to orchards, as the poison so distributed continues effective for a long period during the winter.

Pocket mice did a considerable amount of damage to grain in parts of Adams and Franklin Counties, Wash. A few farmers applied control measures, but relatively little work for the destruction of these rodents was undertaken, despite the fact that pocket mice can be controlled very easily.

In the control of kangaroo rats, which at times cause extensive damage to open ranges, a limited amount of assistance has been given landowners. In many instances, where infestation is heavy, kangaroo rats are a critical factor in determining the numbers of livestock that can be grazed on the area and interfere materially with natural reseeding by destroying quantities of seeds of native grasses. They also attack fields of sprouting grain and various vegetable crops. As a result of demonstrations given in El Paso County, Tex., several hundred pounds of oatmeal baits were distributed to protect the cantaloupes on irrigated lands. An expenditure of $30 in this instance saved several thousands of dollars worth of melons to the producers.

WOODCHUCKS.

Many complaints of unusual abundance of woodchucks and damage by them have been received during the year from points throughout the northern United States. These animals not only damage garden vegetables, but also alfalfa, clover, and other valuable forage plants. Their burrows often cause erosion to start, resulting in the washing out of extensive gullies. Investigational work was conducted in the Eastern States with a view to determining baits and

poisoning or fumigating methods which would be effective in destroying these animals.

In the Northwestern States woodchucks did considerable damage to alfalfa and clover crops adjacent to the rocky ridges amid which they live. The most extensive campaign against them was conducted in Okanogan County, Wash., but some work was also done in Douglas, Grant, Kittitas, and Yakima Counties in the same State. It is estimated that about 19,000 woodchucks were killed there, affording protection to nearly 10,000 acres of crops and resulting in a substantial saving.

HOUSE RATS AND MICE.

The bureau continued to furnish information through bulletins and special articles on the destructiveness of house rats and mice, the danger to health involved in their presence, and the practical methods possible for their control. This information has been very widely used by magazines, farm journals, and newspapers, and by educational workers and public-spirited citizens in bringing to the attention of individuals and communities the importance of applying direct, vigorous measures for the eradication of these pests. Two specialists of the bureau have been engaged during a large part of the year in demonstrating control measures through the extension services of the agricultural colleges and in assisting with the organization of antirat campaigns in States east of the Mississippi River. The entire force of rodent-control specialists employed by the bureau in States west of the Mississippi has also cooperated in a similar way in arousing interest in this important undertaking and aiding in the organization and conduct of campaigns looking to the eradication of these animals. In this way practically nation-wide attention has been given to the matter of getting rid of rats, and greater repugnance is being manifested to the presence of these pests and an intolerance of the waste due to their depredations.

Effort toward rat riddance has assumed larger proportions and more definiteness of procedure. It is coming to be recognized that the intelligent and persistent application of a few simple measures will serve to rid a farm or a community of rats. Experience has shown that rats can not long survive a concerted and sustained campaign against them. During the year the bureau has given particular attention to the working out of detailed plans of organization for use in large-scale operations. Looking to the permanent elimination of the rat pest, emphasis has been placed on the following features: Ratproof construction or repair of buildings; the closing of all openings which provide entrance for rats, including the screening of basement windows; prompt disposal of garbage and elimination of piles of trash and refuse where rats find food or harborage; the poisoning of rats with barium carbonate in barns, granaries, warehouses, and other buildings in which the use of poison is practicable; systematic trapping where for any reason the use of poison is inadvisable; the fumigation of rat burrows with carbon bisulphide or hydrocyanic-acid gas; the use of effective rat dogs; and the organization of community rat-killing drives. The plans of procedure which are being followed involve educational effort to arouse the public to a definite realization of the damage and danger involved

in the presence of rats and to stimulate definite operative measures for the exclusion and destruction of rats.

One of the most striking instances of an extended and well-organized antirat campaign was that undertaken during the year in the State of Virginia. Two specialists of the bureau cooperated with the extension service of the Virginia Agricultural College, including the county agents and home-demonstration workers. Other State agencies also joined actively in the undertaking. The governor issued a proclamation on the subject. The Virginia Department of Agriculture distributed campaign publicity. The Virginia division of markets put on an advertising campaign and assisted in numerous other ways. The State Board of Education carried the message of rat riddance effectively through the schools. The State Board of Health issued circular letters and other publicity matter. The State Farm Bureau Federation purchased and distributed all poison used, besides giving out much publicity and aiding the organized effort in many ways. The Virginia Bankers' Association sent out letters to all bankers within the State urging their cooperation and financial support. The Virginia Parent-Teachers' Association sent a letter to all local parent-teachers' associations urging their participation. The Cooperative Educational Association sent out circular letters urging cooperation. Other organizations, including the Farmers' Union, the State organization of Rotary Clubs, the Peanut Growers' Association, local chambers of commerce, farm bureaus, women's clubs, farmers' clubs, and many others entered heartily into the campaigns. Banks, farm bureaus, county commissioners, merchants, and many other organizations were liberal in financial assistance, and the newspapers of the State responded in a most gratifying and helpful way by giving many columns of space to the campaign propaganda. Valuable support came from the public schools, many of the campaigns being carried out almost exclusively through them.

Carefully compiled reports from the county agents of 71 counties in which the campaigns were conducted indicate that more than 500,000 rats were destroyed, and persons competing for prizes turned in 91,365 rat-tails; 158,198 people participated in the campaigns; 44,198 pounds of barium carbonate were distributed; 125,585 pieces of publicity material were circulated; 126,000 copies of poison directions, 10,000 posters, and 21,900 mimeographed letters and circulars were issued by the Virginia Extension Service; and prizes offered for rattails totaled $2,332 in value.

The total cost of the Virginia campaign was $7,444. As the average damage done by a rat in the course of a year is estimated at $2, the number of rats reported destroyed would represent a saving of produce and other property of more than a million dollars.

Important by-products of such campaigns are the interest aroused and definite action taken looking toward improved sanitation in individual homes, on farms, in villages, and in cities. The adoption of ordinances providing for the construction and repair of buildings with a view to the exclusion of rats and the improvement of sewage and garbage disposal frequently follow. The active and effective participation of the people of a community in such a concerted drive also cultivates a sense of community responsibility, a tendency to-

ward individual and community thrift, and a spirit of community teamwork that is far-reaching in its influence and helpfulness.

The development of the poultry industry in many sections of the country has brought a realization of the seriousness of the damage wrought by rats as destroyers of eggs and young chicks, and as possible carriers of avian tuberculosis. Much interest has been manifested in rat destruction by poultry producers, and special attention has been given by the bureau to meeting their requirements.

Investigations have been continued to improve methods of combating rats, including experimental studies of the effectiveness of various rat viruses on the market. Laboratory studies and field trials were made in cooperation with the Bureau of Animal Industry, and a number of agricultural college experiment stations also conducted bacteriological studies and laboratory tests of these products, all of which confirmed former conclusions that the use of poisons now available give more economical and effective results.

MOLES.

Due to widespread complaints regarding damage by moles in lawns, gardens, truck farms, pastures, and hay meadows, the bureau has continued investigations designed to simplify and make more effective methods for combating these animals. Assistance has been given those who have reported damage due to moles by furnishing them, through correspondence, bulletins, or demonstrations, information on the most practical known methods for their control.

PRODUCTION OF DOMESTIC RABBITS.

Inquiries continually come to the bureau regarding the production of domestic rabbits as a source of meat and fur. The bureau has kept in touch with officials of National and State organizations of rabbit breeders, and information has been furnished regarding the care, feeding, and management of these animals. Recommendations have been made, in cooperation with the Bureau of Agricultural Economics, regarding procedure which would afford the most satisfactory results in developing a market for the animals produced.

FUR-BEARING ANIMALS.

Investigations regarding the rearing of fur-bearing animals in captivity have been carried forward vigorously during the past year, and progress of a very fundamental character has been made. The bureau has kept in close touch with those engaged in rearing fur-bearing animals, with dealers in raw furs, and with those engaged in dressing and dyeing furs and manufacturing fur products.

The formation of State and National organizations designed to serve the interests of the industry, to gather information regarding the progress made, and to establish an adequate system of record and registration has been encouraged. Most gratifying progress has been made along these lines. Encouragement has also been given to the enactment of legislation which would prove effective in the conservation of fur-bearing animals with a view to maintaining a permanent supply. In response to requests, assistance has been given a

number of States in revising existing laws or in framing new ones relative to protecting and rearing fur animals.

The active help of State game commissions, conservation societies, and the fur trade has been enlisted in conserving the wild fur bearers, since maintenance of a supply adequate to meet the requirements of the fur trade is of the utmost importance. An encouraging step was taken at the recent International Fur Exposition, held in New York City, where those assembled went on record as favoring the formation of a national association for the purpose of devoting considerable effort to the study of the problems of conservation as they affect the industry. The fur trade realizes that the future of the industry is dependent upon an assured source of supply of raw furs.

Fur farming is coming to be an important factor in the maintenance of the supply of fur-bearing animals and its development along sound lines is being encouraged. The number of persons engaged in the production of silver foxes in captivity is steadily increasing, and great interest is being manifested in this and other lines of fur production. Since the production of fur bearers in captivity is a comparatively recent enterprise it is not supported by the exhaustive research data enjoyed by similar industries of longer standing. Constant effort is being made by the bureau through its scientific investigations to obtain the information essential to the requirements of this growing industry.

Important progress has been made in studies of fur-bearing animals at the experimental fur farm at Keeseville, N. Y., including investigations of the prevalence of internal and external parasites of foxes, determinations of the age and seasonal susceptibility of the animals to infestation and their tendency to develop immunity toward such infestation, and experiments with remedial agents for the removal of parasites. Improved methods of administering remedies have been devised and valuable data have been secured regarding the tolerance of foxes to various medicinal drugs. Such information is essential to proper treatment at various ages and under different conditions of health and vigor. As a basis for clinical and diagnostic work studies have been continued of various features of the physiology of foxes, including the pulse, respiration, and temperature.

A number of fox farms were visited for the purpose of studying outbreaks of contagious disease, as fox influenza, which in some instances proved serious.

Experiments were continued with pens so equipped with concrete or board floors that they can be washed daily, to determine their effectiveness in preventing the infestation of foxes with internal parasites. Special attention was given to the use of these pens at the time of whelping and for care of the pups during the first few weeks, and they were found to be much better for use at whelping time than pens with earth floors.

A bulletin on silver fox farming, which reviews the history of fox farming and covers such essential features as suitable sites for a ranch, proper organization, and satisfactory practices in breeding, feeding, and management of foxes, was published during the year. As an indication of the interest in fox farming, it may be stated that applications were filed for a large portion of the original edition of 10,000 copies of this bulletin before it had left the press.

The chief fur expert of the Biological Survey made an extended trip among the blue-fox farms of Alaska during the early part of the year on the bureau's power cruiser *Sea Otter* and obtained valuable information which it is intended to publish in a bulletin on the blue-fox farming industry. In cooperation with the chief fur warden of the bureau and representatives of the Forest Service, he assisted in the organization of two associations of blue-fox farmers.

FOOD HABITS RESEARCH.

EXAMINATION OF STOMACHS OF BIRDS.

In the course of the fiscal year 2,302 stomachs of birds were received and incorporated in the collection, preparatory to examination. Laboratory work on the examination of various bird stomachs included 561 English sparrows, making the total examined for this species about 5,100. Examination of the stomachs of five species of shore birds has been completed and the data secured therefrom tabulated, preparatory to the preparation of a report on their economic status. In a continuation of a study of the food of birds of prey 331 stomachs and 248 pellets representing 10 species were analyzed. Considerable recently acquired material of fish-eating birds has been examined with the object of incorporating the data obtained in the manuscript previously prepared on the food habits of these birds. Additional material examined includes stomachs of band-tailed pigeons, studied in their relation to grain crops in California, and of domestic pigeons in relation to an imported snail now destructive in the vicinity of La Jolla, Calif.

In response to a request from persons in the Dominican Republic engaged in raising cacao, examination was made of two lots of stomach material of the "carpintero," a woodpecker having rather pronounced vegetarian habits. From the food preferences revealed it is apparent that this bird may become destructive to corn and the cacao, into the green fruit of which it drills holes to feed on the pulp. Other examinations made for correspondents included stomachs of ruffed grouse, from NewEngland; pileated woodpeckers and pigmy owls, from Oregon; several species of hawks and owls, chiefly from New York; crossbills, from Illinois; swifts, from Washington; and wild ducks, from Argentina.

PINYON JAY CONTROL.

The status of the pinyon jay in its relation to grain crops was investigated during the year, and measures for control during the corn harvest were devised. Damage by the bird to wheat also occurs when it is in the shock, and the year's efforts were directed toward finding effective and economical means of control during that period. Experiments conducted in Colorado indicated that poisoning is only moderately successful during the wheat harvest and is economical only in small fields so situated that there is likely to be a concentration of jays in a limited area which can be baited. The great danger of killing mourning doves through poisoned baits placed in wheat stubble precludes the possibility of extensive poisoning campaigns against pinyon jays during the wheat harvest. Recommendation was made, therefore, that control measures for these birds be

conducted during the corn season wherever this crop is grown, and during winter wherever the birds congregate.

RELATION OF GROUSE TO ORCHARDS.

During the winter of 1922–23 the bureau received complaints of depredations by ruffed grouse feeding on the buds of apple trees in several of the New England States. In New Hampshire the situation resulted in a public hearing being called at Concord, at which the Biological Survey was represented for the purpose of presenting data on the food habits and economic tendencies of these birds. From the information presented at this hearing and from other sources it is apparent that grouse have become very abundant during the past few years and under some conditions are inflicting damage. Reports to this effect have been substantiated by stomach examination of birds collected. History shows that the abundance of grouse runs in cycles of years, and it is believed that the present condition is temporary, and that a year or two will see a reduction in their numbers with a resultant decrease of damage.

WILD-FOWL FOOD RESOURCES.

Continued progress was made in the survey of aquatic food for wild fowl, work being done in Maine, New York, Minnesota, Michigan, and Montana. Owing to the multitude of lakes in Minnesota, work in that State will have to be continued at least one more season before representative bodies of water in all lake regions of the State can be studied. In Montana 25 localities were investigated in carrying out a cooperative project, and as a result a report on the wild-duck foods of Montana was prepared for publication. In Michigan another cooperative piece of work was started in which local assistance was given investigators of the bureau in a survey of aquatic plant life. In Maine the waters of Lafayette National Park and a few lakes on the near-by mainland were surveyed. In connection with all this work recommendations for the improvement of the waters studied were made to interested persons.

MISCELLANEOUS WORK IN ECONOMIC ORNITHOLOGY.

A preliminary investigation was made of the relation of pelicans to trout and other fish in Pyramid Lake, Nev. It is planned to make a thorough study of this problem during the next breeding season of these birds.

A special survey of Jekyl Island, Ga., was made, with recommendations for improving conditions for bird life in general.

Important additions have been made to the reference study collections of various kinds, all of which assist materially in the study of food habits. These included insects, mollusks, crustaceans, other invertebrates, and vertebrates of various kinds, as well as seeds and other plant structures.

A manuscript on the magpie in relation to agriculture, based on the examination of 547 stomachs, has been prepared. Its publication, however, will be delayed until the results of control experiments planned for the winter of 1923–24 can be incorporated in it.

Manuscript for a revised bulletin on bird houses also has been largely completed, along with a series of sketches illustrative of principles in bird-house construction. A circular on the various names by which migratory game birds are known locally is in press.

WAR GASES AS BIRD-CONTROL AGENCIES.

Through a cooperative arrangement with the Chemical Warfare Service, experiments were conducted at the Edgewood Arsenal, Md., to determine whether some of the common war gases might be of use in the control of certain injurious birds, which for one reason or another do not lend themselves to poisoning operations. Use was made of the ample facilities for such work at the toxicological laboratory at the arsenal, and through the cooperative help of the laboratory staff extensive series of asphyxiation tests were made for the purpose of discovering a gas that would be lethal to birds, yet safe to use in agricultural sections.

English sparrows and domestic pigeons were used in the tests and were subjected, in varying concentrations and exposures, to the action of phosgene, " mustard," methyldichloroarsine, chloropicrin, chlorine, and bromocyanogen. A comparison of the results here obtained with the lethal dose for a dog (considered to approximate that for a human being) indicated that consistent results could not be expected against the birds in doses less than one-third of the lethal dose for man. In some instances birds survived after being subjected to a full lethal dose for a human being. Owing to the fact that such high concentrations are required, as well as to the factors of cost and the difficulty of handling, it is apparent that, with the possible exception of a limited use of chlorine or chloropicrin, the common war gases have no utility as bird-control agents. Chlorine and chloropicrin, as well as the others, can be released only in sections where their effect on vegetation would not be objectionable.

FOOD HABITS OF REPTILES AND AMPHIBIANS.

Progress has been made in the study of the food habits of reptiles and amphibians, including the critical examination of 642 stomachs of toads, representing 19 species, from North and Central America and the West Indies. Important additions were made to the card-index files on subjects relating to food habits, behavior, life histories, and other general information regarding reptiles and amphibians. A mimeographed account of the common toad, including information on its range, life history, and economic status, was prepared. About 550 stomachs of amphibians were added to the collection, including 300 presented by Cornell University.

EXAMINATION OF STOMACHS OF MAMMALS.

An examination of 85 stomachs of grasshopper mice was made and a report prepared on the food habits of these beneficial rodents. Approximately 380 stomachs have been added to the collection during the fiscal year.

BIOLOGICAL INVESTIGATIONS.

As during previous years, the work of the Division of Biological Investigations has been conducted with the view of furnishing the basic scientific information needed for the proper administration of the various duties intrusted to the bureau—the enforcement of the migratory-bird treaty act and the Lacey Act, the management of big game and bird refuges, the numerous activities bearing on the conservation of game birds and mammals, and all the varied relations of birds and mammals to agriculture, forestry, and animal husbandry. Owing to the limitation of funds the biological surveys of States, as well as other field activities, have been curtailed. Progress has been made in adding to the files of information, mainly in the form of card indexes, on the distribution, abundance, and habits of North American mammals, birds, reptiles, and amphibians. These files, being an accumulation dating from the establishment of the bureau many years ago, now contain by far the largest mass of data on wild life in readily accessible form in existence. They comprise notes gathered from all available sources, including the field notes of the bureau staff, published accounts in books and periodicals, manuscripts from volunteer observers and friends of the bureau, and notes gleaned from correspondence and other sources. The value of the card catalogues is constantly increasing; they are in daily use to furnish information desired by other government departments, officials of State and municipal organizations, museums and other educational institutions, and individuals throughout the United States and in many foreign countries.

BIOLOGICAL SURVEYS OF STATES.

Actual field work in connection with State surveys was confined to Wisconsin, Arizona, and Florida. In Wisconsin a field party worked during August and September in several widely separated sections, visiting a number of localities the fauna of which still needed investigation. In October an assistant visited the northwestern part of Arizona, completing certain field work required in that section of the State. Through the generosity of a naturalist friend of the bureau, who paid the expenses of an investigator, it was possible to make a survey of the bird and mammal life of a considerable area in central Florida during March, April, and May, thus adding materially to our knowledge of the distribution and breeding habits of the birds of that region. Several rare and interesting species were studied in the field and valuable original data obtained.

Progress was made also in the preparation of reports on the fauna of States. A report on the mammals of Wyoming was completed and one on the mammals of Oregon is partly completed. Reports on the birds and mammals of the State of Washington and of the birds of Florida are well advanced. Other reports already completed but awaiting publication include annotated lists of the mammals of New Mexico and North Dakota and of the birds of New Mexico and Texas.

DISTRIBUTION AND MIGRATION OF BIRDS.

Bird migration reports were received from about 285 volunteer observers; a number of these have been sending in records from the same localities for more than 20 years, and a few as long as 30 years. The cumulative value of such series of records can scarcely be estimated. The card catalogue of the bird collection was brought up to date, and considerable work was done in rearranging the study collection of birds.

BIRD CENSUSES.

Reports on the birds breeding on definite areas, usually selected as affording a variety of topographic conditions and different types of vegetative cover, numbered about 100, nearly double the number received during the previous year. Many of these involved areas which had been reported on during several previous years, thus affording an index to such local fluctuations in bird life as may have occurred. A publication on this subject, the third report on bird censuses in the United States, covering the period from 1916 to 1920, inclusive, was in press at the close of the year.

BIRD BANDING.

The work of banding birds, as an aid to the study of distribution and migration, made material progress during the year. More than 25,000 birds were banded and the number of cooperators increased to 851, of whom 63 are in Canada. During the shooting season 668 returns of banded ducks were reported, which has added much to our knowledge of the seasonal movements of these important species. There has been a gratifying increase in the number of persons undertaking the operation of trapping stations, by means of which the best returns of the small nongame birds are obtained, and the results have been correspondingly satisfactory.

In October the Inland Bird Banding Association, formed to coordinate the activities of cooperators of the bureau in the Mississippi Valley, was organized in Chicago, the work of this organization being in a measure similar to that of the New England Bird Banding Association, which was formed in 1921. Plans have been formulated looking to the organization of similar regional associations covering the Atlantic seaboard and the Pacific slope.

An important feature of the year's progress has been the perfecting by a private firm of machinery which makes it possible to manufacture numbered aluminum bird bands cheaply and in large quantities, thus solving what has heretofore been a perplexing problem.

During the year two important field trips were made by an assistant for the purpose of banding ducks. The first expedition, covering most of October and November, involved trapping and banding ducks on an extensive scale on the grounds of the Sanganois Club, near Browning, Ill., where similar work had been done during the early spring of the same year. By means of traps of wire netting it was possible to capture and band over 1,300 ducks, including mallards, black ducks, and pintails. It is expected that many interesting returns will be reported during the fall shooting season. Another trip was made in January to Oakley, S. C., for the purpose of examining a proposed station for trapping and banding ducks. The con-

ditions seem to be favorable and it is believed that a productive station can be established there.

No official publications have been issued, but several articles on bird banding in ornithological periodicals have been reprinted in quantities and made available to collaborators through the generosity of an ornithologist who is much interested in this project. Addresses on the subject of bird banding have been made by representatives of the bureau at Camp Bradley, Md.; in Boston, Mass.; and in New York City.

INVESTIGATIONS OF MIGRATORY WILD FOWL.

Investigations concerning the condition of migratory wild fowl have been carried on, mainly in cooperation with State officials, thus adding materially to our files of information concerning the distribution, migration, and breeding of these important game species, and serving an important purpose in the administration of the migratory-bird treaty act. Birds collected under scientific collecting permits during the calendar year 1921 have also been carded, bringing the data regarding this activity up to date.

It will be recalled that in 1922 concerted efforts were made by certain sportsmen, notably in Missouri, to be allowed a shooting season extending from February 10 to March 10, the contention being made that the birds were not mated during this period. In that year an investigation made by the bureau showed that mallards were paired as early as February 21, while specimens of both sexes taken early in March showed functional activity of the breeding organs. In order to gather additional data an assistant visited some of the more important wild-fowl resorts in Missouri frequented by these birds during the northward migration. The period covered was from February 20 to March 7, 1923, and the data thus obtained in southeastern Missouri concerned mallards, pintails, and hooded mergansers. Anatomical examination of specimens taken February 21 to 23 showed that many of the birds were in breeding condition. About 73 per cent of the mallards examined here between February 20 and 27 showed decided enlargement of the reproductive organs. Observations made at another locality in Missouri March 1 to 7 disclosed nearly similar conditions.

The participation of a representative of the bureau in the session of the American School of Wild Life Protection, held at McGregor, Iowa, in August, 1922, afforded opportunity for the presentation on a broad scale of the methods and policies of the bureau regarding the protection of wild life. Besides the influence exerted directly at these sessions, which were attended by sportsmen and game officials and many other persons representing organizations interested in the conservation of the wild-life resources of the Mississippi Valley, a number of short trips to near-by points were made in the interests of related projects. These included an inspection of a proposed game preserve near Garden City, Kans., and examinations of Clear Lake, near Mason City, Iowa, and Rice Lake, near Lake Mills, Iowa, localities formerly inhabited by considerable numbers of breeding wild fowl, and where it is desired to institute more effective protective measures. An examination was made also of the Winneshiek bottoms near Lansing, Iowa, in company with

Iowa and Minnesota officials, to determine the advisability of draining the area.

Another representative of the bureau, while investigating the condition of migratory wild fowl in South Dakota, with special reference to the breeding of wild geese, made an examination of the Chase Lake Bird Reservation. Reports of damage to shocked wheat by mallards in Kidder County, N. Dak., before the opening of the shooting season, were also investigated and found to be borne out by the facts. About the same time Island Lake, in Aitkin County, Minn., proposed as a game refuge, was thoroughly examined. It was found to be a comparatively small wooded island, and while its fauna and flora were found to be interesting, its establishment as a Federal game refuge was not considered desirable.

In April, a member of the staff, while investigating the distribution of birds and mammals in Florida, visited the Island Pond and Spruce Creek breeding rookeries near Maytown, and a series of rookeries on Sebastian River near Roseland, for the purpose of estimating the numbers of breeding herons, egrets, and ibises.

WILD LIFE ON NATIONAL AND STATE PARKS AND FORESTS.

An assistant of the bureau made an examination of the Grand Canyon National Game Preserve, Ariz., late in September and early in October, to obtain information regarding conditions affecting game, with special reference to making plans for disposing of the surplus deer on this refuge. Reports indicated that the mule deer on this preserve, the only large game there, had increased to such an extent as to overstock the ranges, especially in summer. The trip was a cooperative one, the Biological Survey representative being associated with officials of the Forest Service concerned with the administration of the Kaibab National Forest, within the boundaries of which the game preserve is located. Deer were found to be very abundant, it being estimated that upward of 20,000 were present. Late in March and early in April, 1923, another investigation was made of the region, the personnel including the same bureau representative and most of the same members of the Forest Service.

In general, the observations made on this trip confirmed the findings of the previous examination. Notable concentration of deer was observed in certain areas of bench land so situated topographically that movement of the animals to less crowded sections was difficult. While no suffering from lack of winter forage is yet apparent, excessive utilization of the summer forage is evident, as well as undesirable concentration on parts of the winter range, and it is believed that material reduction in the number of the deer is advisable, unless migration to less crowded areas can be induced.

Following the investigation of the Grand Canyon Game Preserve an examination was made, in cooperation with the National Park Service, of the Tonto Plateau, Grand Canyon National Park, to ascertain its suitability as a prospective preserve for antelope. The area was found to be fairly well suited to this purpose, except that it is considerably overgrazed by burros, the descendants of animals abandoned in the canyon many years ago. Since the burros serve no useful purpose, their removal or elimination is considered advisable,

and in case this can be accomplished, the successful establishment of a small herd of antelope is considered to be practicable.

A final examination was made of game conditions on the Wichita National Game Preserve and a report made to the forester with recommendations for handling the game there and for disposal of the surplus.

As a matter of cooperation in methods of administering parks and forests, with special reference to their wild-life resources, an assistant of the bureau attended the North Carolina Forestry Convention at Pinehurst, January 23 and 24, and the Third National Conference on State Parks, held at Turkey Run State Park, Ind., May 7 to 9, at each of which he delivered addresses on the relation of wild life to forests and parks.

LIFE HABITS OF INJURIOUS ANIMALS.

Detailed experiments with captives of several species of injurious rodents, with special attention to breeding habits, were carried on during the year. The species studied included meadow mice, pocket gophers, kangaroo rats, pocket mice, grasshopper mice, and jumping mice. These studies disclosed many interesting habits hitherto unknown, especially with reference to the rapidity of breeding in certain species. These laboratory results admirably supplement field studies previously made on the same species and assist in interpreting habits imperfectly understood. Reports on the results of studies of meadow mice and grasshopper mice were prepared for publication. Intensive field studies also were made of certain injurious rodents in Washington and Oregon, especially mountain beavers, pocket mice, pocket gophers, and silver gray squirrels.

Late in October and early in November assistants of the bureau made an examination of the plots established in Arizona in cooperation with the Forest Service, the Carnegie Institution of Washington, and the University of Arizona, to determine quantitatively the damage effected on forage plants or stock ranges by certain rodents. These experimental plots are so arranged as to furnish data on the varying conditions of vegetation on fenced plots of uniform size, rodents of different species and cattle being given access or excluded to simulate the different natural conditions. A report on the results of a study of the feeding habits of prairie dogs and the quantitative damage to forage plants by these pests has been prepared for publication.

An intensive study of the habits of jack rabbits, with special reference to their economic status, has also been undertaken.

Early in October an assistant of the bureau, in cooperation with an official of the Bureau of Plant Industry, made a reconnaissance of Coachella Valley, Calif., as the first step in a proposed intensive study of the geographical and ecological relations of the fauna and flora of this region, which is believed to be potentially one of the richest agricultural areas in the State. Dates are the most important crop and their culture is being studied at the Government date garden, at Indio. Several native rodents are believed to be injurious to this crop. The time spent was too short to afford results of importance, but this preliminary survey gives promise of information of great practical value should it be possible to continue investigations there.

INTRODUCTION OF TROPICAL AMERICAN GAME BIRDS.

For some years the Biological Survey has been interested in having experiments made for the introduction and acclimatization of the ocellated turkey, a wonderfully beautiful game bird found from Yucatan to Honduras, and the curassow and possibly other game birds of the same region. In the spring of 1923, a cooperator of the bureau provided the funds needed to send a naturalist to the Lake Peten region of Guatemala to secure a stock of living birds for this experiment, the birds when received to be placed on islands off the coast of Georgia. The leader of the expedition reports that a considerable number of young ocellated turkeys and other birds are being raised for this experiment by Indians under his supervision.

INVESTIGATION OF INTRODUCED QUAIL.

Within the past eight years large numbers of quail, or bobwhites, have been introduced into Pennsylvania and Maryland from northern Mexico in an attempt to replenish the depleted covers. These birds belong to a form which differs from the native birds in smaller size and paler or grayer coloration. It is a matter of much interest to ascertain to what extent the introduced birds have increased and whether they interbreed with the native stock. To obtain these data a representative of the bureau, in cooperation with members of the State game commissions, during the hunting season visited the sections of those States affected by the introductions and collected specimens from as many coveys as possible. The results showed that interbreeding between the imported and the native stock had taken place in a number of instances, while a few birds which showed only the characters of the imported birds may have been either members of the original importations or their descendants. This investigation will be continued, as the results will have a practical bearing as well as a scientific value.

HAWAIIAN ISLAND EXPEDITION.

Some years ago a German living on Laysan Island, a celebrated breeding place of enormous numbers of albatrosses and other notable sea fowl, and within the Hawaiian Islands Bird Reservation, introduced the European rabbit. The multiplication of these animals on this wonderful island made it evident that they must be exterminated if the vegetation and some of the species of birds peculiar to the island were to be saved. In the spring of 1923, through the cooperation of the Navy Department, a vessel of 1,000 tons capacity was detailed for four months to provide facilities for a careful scientific reconnaissance under the direction of a representative of the Biological Survey of all of the islands in the Hawaiian Islands Bird Reservation and others adjacent thereto, including Wake and Johnston Islands. Through the active cooperation of the Bishop Museum, of Honolulu, the scientific personnel of the expedition included a botanist, an entomologist, an anthropologist, a geologist, and other scientists. The present survey of these islands is one of the most complete ever undertaken in the Pacific.

Word has been received that the rabbits have now been exterminated on Laysan, although before the arrival of the expedition they had almost completely destroyed the vegetation. Plants and seeds were subsequently obtained in Honolulu and planted on Laysan, where undoubtedly vegetation of a more varied character than heretofore will flourish. One of the interesting results already reported is the finding about this and other islands of considerable numbers of the little-known Hawaiian seal.

ALASKA INVESTIGATIONS.

REINDEER.

At the beginning of the bureau's reindeer investigations, in 1920, the reindeer experiment station was established at Unalakleet, on the shore of Norton Sound. By July 1, 1922, the work had developed to a point that made it advantageous to move the station to Nome, where there is a more suitable building, with a barn and corral for conducting experiments.

FEEDING EXPERIMENTS.

In order to conduct feeding experiments, in the fall of 1922 seven reindeer—four adults and three fawns—were procured from a Government herd located 25 miles from Nome and brought to the experiment station. Until the animals became accustomed to their new quarters they were fed reindeer moss. Later moss was mixed with other feed, and finally eliminated altogether. Only about 15 days were required to wean fawns completely from the use of moss, but it took much longer for the adults. The feeding experiment proved very successful and was one step toward demonstrating the possibility of utilizing reindeer far more extensively in travel and winter transportation than is now being done. Further experiments will be conducted to determine the quantity of forage necessary each day for a sled animal traveling long distances. As carrying space on sleds is at a premium on long trips, the weight and bulk of food necessary to be taken along for sled animals is of prime importance.

GENERAL OBSERVATION WORK.

The bureau's auxiliary power schooner *Hazel*, used for reindeer investigational work on the Bering and Arctic coasts, traveled a total of 3,573 miles during July, August, and September, proceeding south to the town of Bethel, on the lower Kuskokwim River, and north to Kotzebue Sound. These cruises were made for the purpose of investigating the condition of the herds and for studying the herds and methods of herd management. At the same time educational work was undertaken with the herd owners for the purpose of introducing improved management, which is already showing results, especially in methods of castration, in branding, and in the handling of herds on the range. Collections made of forage plants and the studies of their abundance and distribution supply invaluable information necessary for the wise allotment of grazing areas to herd owners when such allotments are authorized by law.

RANGES.

Careful investigations were made of the kind and distribution of forage plants and of the grazing capacity of the reindeer ranges over a large area. The vital importance of this investigation has become evident since it was learned definitely that in winter reindeer are almost entirely dependent on reindeer moss. This involves the necessity of providing summer and winter grazing areas for each herd, in which the "moss" or winter areas must be larger than those for summer, when grass and other ordinary herbage is eaten. This fact has necessitated a change in computing the grazing capacity of reindeer ranges from a basis of 30 acres per animal to from 40 to 60 acres. On this new basis it is estimated that Seward Peninsula alone would carry approximately 200,000 head.

CARIBOU INVESTIGATIONS.

The field naturalist with headquarters at Fairbanks continued his investigations of caribou during the year and obtained much valuable information during an extended winter trip through the Endicott Range country and back to Fairbanks by way of Fort Yukon.

INVESTIGATION OF REINDEER INDUSTRY IN NORTHERN EUROPE.

The investigation of the reindeer industry in northern Europe, conducted in August and September by the bureau's former chief specialist in the reindeer investigations in Alaska, proved not only very interesting but of much value in its relation to the reindeer investigations now being made. The Norwegian reindeer were found to be smaller than the Alaskan animals, and less fat, both characteristics probably being due to the depleted ranges. The heaviest reindeer were found in Lapland. In Norway reindeer were found to be very healthy as a rule and less attacked by warble flies than in Alaska, the constant moving of the herds being given as the cause for this freedom from parasites. The frequent moving of herds recommended by the bureau's experts in Alaska in 1921 is now being followed by many herd owners in the Territory, with beneficial results.

PROTECTION OF LAND FUR ANIMALS.

Some progress has been made in the work of protecting land fur animals in Alaska, but not so much as is desirable, owing to the inadequate law and to the limited funds available for the purpose. The practical value of educational work to emphasize the need of better conservation of both the game and fur animals of Alaska is shown by the rapid growth of favorable sentiment in the Territory and by an increasing appreciation of the work being done along these lines by the bureau.

The only important change in the fur regulations during the year related to the protection of blue foxes, and was made at the request of the blue-fox farmers in order to prevent poaching, an evil practice which was becoming a serious menace to the industry. This regulation, promulgated on January 9, prohibits the killing of blue foxes at all times in district 1, except on the Aleutian Islands Res-

ervation, and in district 2, south of latitude 62°, with the exception that the duly authorized agents, owners, lessees, or permittees of islands and lands used and maintained as fur farms for the propagation of blue foxes may kill at any time the animals in their possession.

A fur warden was appointed at Nome, and warden service was maintained during parts of the year at Fairbanks, Unalaska, Anchorage, Juneau, Cordova, and Belkofsky. Excellent cooperation was given by the customs division of the Treasury Department and by agents of the Department of Justice. Plans have been made for extending fur-warden service by the appointment of regular wardens for the Kuskokwim region and for that about Fairbanks.

The fur warden stationed at Nome made a careful investigation of conditions in regard to fur-bearing animals along the Kuskokwim River early in 1923, traveling a total distance of 1,603 miles by dog team and going as far south as Bethel. Valuable information was obtained regarding land fur animals, one important fact being noted that, with the possible exception of the beaver and the marten, the fur bearers were more than holding their own. Serious forest fires, however, have ruined many miles of marten territory in the Kuskokwim region. The establishment of a Forest Service fire patrol in interior Alaska is seriously needed and will be of enormous value to the future welfare of the Territory. Fires annually destroy vast areas of timber valuable for local use and forage for game and reindeer that can not be replaced in many years.

PROSECUTIONS AND SEIZURES.

Only two arrests were made for violations of the fur law, each resulting in a conviction and fine. A number of contraband skins were seized, but the possessors were not prosecuted, owing to defects in the fur law which make successful prosecution doubtful.

Reports of the use of poison and explosives in the destruction of beavers, their dams, and their houses continue to be received and present the most serious danger to the future of the fur animals that exists. So many beavers were killed during the recent open season that a general desire has been expressed by people from all parts of the Territory for another extended close season.

With an adequate fur law and sufficient funds to enforce it, proper protection could be given to the land fur-bearing animals of the Territory, and thus perpetuate and increase one of its most valuable natural assets.

SHIPMENTS OF ALASKA FURS.

Shipments of furs from the Territory continue to form an important item of its annual production. According to reports made to the bureau by postmasters and agents of transportation companies, covering the year from December 1, 1921, to November 30, 1922, the number of furs shipped greatly exceeded that for the previous year. Only 254,788 skins were shipped during the year ended November 30, 1921, while 394,514 were shipped in 1922. Exclusive of white and blue foxes of the Pribilof Islands, which are under the jurisdiction of the Bureau of Fisheries, the value of the skins of land fur bearers shipped for this year amounted to $1,732,693. The number of the principal pelts shipped and their value were as follows:

Kind of fur.	Number.	Value.	Kind of fur.	Number.	Value.
Muskrat	313,145	$391,431	Beaver	12,216	$250,587
Blue fox	1,080	118,800	Land otter	1,899	43,677
White fox	4,393	175,720	Mink	31,983	223,881
Red fox	5,979	110,611	Marten	10,385	285,587
Silver-gray fox	291	58,200	Weasel (ermine)	10,656	9,057
Cross fox	740	29,600	Black bear	751	10,138

As a considerable number of furs are used in Alaska and as many are taken out by travelers and by vessels not reporting them, it appears safe to estimate the take of land furs for the year as exceeding a value of $2,000,000, or a 6 per cent return on a capital valuation of about $33,000,000 for this natural resource.

GENERAL ACTIVITIES.

The bureau's seagoing power boat *Sea Otter* has been used continually, patrolling waters and streams of southeastern Alaska, and visiting fur-farming islands and many other points to enforce the fur laws and to enable the chief warden to be of increased practical assistance to the fur farmers. The chief fur warden and other employees of the bureau in Alaska are encouraged to conduct a persistent educational campaign for the better conservation of the fur and game resources of the Territory. Most gratifying results have been obtained in a way that holds out great encouragement for the future.

FUR FARMING IN ALASKA.

During the summer and early fall of 1922 the chief fur warden and the chief fur-farming expert of the bureau made a trip on the *Sea Otter* from southeastern Alaska to Unalaska, studying the fur farms and other matters relating to fur production. The results of this are mentioned earlier in this report under the general subject of fur farming. The fur-farming industry in Alaska appears to have a most promising future.

All but one of the ten islands under the jurisdiction of the bureau for leasing for fur-farming purposes have been leased. It is not considered advisable to grant an exclusive lease on the remaining island.

Fox farming, mainly of blue foxes, is developing rapidly and appears to have a good future in the Territory. Two associations of fur farmers were formed in the fall of 1922, one at Cordova and the other at Petersburg. A list of blue-fox farmers of Alaska with their names, post-office addresses, and the name of the island occupied by each has been prepared and distributed in mimeographed form by the bureau, showing that there are now 99 blue-fox farmers in southeastern Alaska, 29 in the Prince William Sound region, 8 in the Lower Cook Inlet region, 13 in the Kodiak-Afognak region, and 10 on islands off the Alaska Peninsula, or a total of 159. In addition there are about 20 blue-fox farmers in the Aleutian Islands Reservation, while 25 permits have been issued to residents of Alaska to capture alive beavers, minks, martens, and muskrats for propa-

gating purposes. All possible encouragement is given responsible parties who have favorable locations to engage in this new enterprise.

One handicap to the development of the fur-farming industry in Alaska is the lack of authority in any governmental agency to lease the numerous islands which are suitable for the purpose but which are located outside the national forests and the Aleutian Islands Reservation.

PROTECTION OF ALASKAN GAME.

The Alaska game law is administered by the Governor of Alaska under regulations promulgated by the Secretary of Agriculture. Migratory birds in the Territory are protected under the provisions of the migratory-bird treaty act.

The most important change in the regulations during the year in regard to game in Alaska was the elimination of specific protection of deer on Duke, Gravina, San Juan, Suemez, Zarembo, Hawkins, Hinchinbrook, Montague, Long, and Kodiak Islands. Kruzof Island, near Sitka, alone in southeastern Alaska, remains a deer preserve. It is forbidden, however, to kill deer anywhere west of longitude 141°, thus giving this game protection on all islands in that region.

DESTRUCTION OF WOLVES IN ALASKA.

For some years requests have come from citizens of Alaska that efforts be made to destroy wolves, which have been enormously destructive to deer on the coastal islands of southeastern Alaska. Local residents had made efforts for a long period to destroy wolves in that region, and the impression was general that, because of unusual topographic and climatic conditions, these animals could not be successfully destroyed. Our representative working in Michigan was detailed to Alaska for two months, where he demonstrated beyond question that it was not only feasible to trap and poison the wolves successfully on the Alaskan islands, but that it would not be a very difficult matter to exterminate them on most, if not all, of the islands. Thirty large timber wolves were taken by traps or poison, and no doubt, as is usually the case, numerous others killed by poison were not found. The results were so promising that this work will be continued. Destruction of the wolves will be extremely helpful in increasing the numbers of the deer, which are so important a factor as a part of the food supply of the Indians and other residents of that region.

GAME AND BIRD REFUGES.

The continual increase in the number of hunters and the decrease of various species of game are producing a healthy reaction among sportsmen and others interested, causing the establishment of State game refuges. The number of such refuges in a list compiled by the Biological Survey in 1922 was 423, of which 346 contained a total of more than 19,331,000 acres. To these, early in 1923, the legislatures of 12 States added 38, with a total of 3,000,000 acres. Among those of notable interest are several refuges made in Nevada, mainly for the benefit of antelope.

The Shoshone and Pathfinder Federal refuges on irrigation projects in Wyoming were abolished during the year, as they had proved to be of too little value to be retained. This leaves a total of 68 Federal bird and big-game refuges administered by this bureau.

BIG-GAME REFUGES.

During the last part of June the 12-mile big-game fence which had been under construction at the Niobrara Reservation, near Valentine, Nebr., for several years was completed. It incloses approximately 4,000 acres of ideal range for big-game animals adjoining the two small areas heretofore available for this purpose.

The winter of 1922–23 was a comparatively mild one in the West, enabling game in general to come through in satisfactory condition. The increase in game animals on the refuges was satisfactory, the one item of disappointment being the misfortune which overtook the antelope herds on the Bison Range and the Wind Cave Refuge. The difficulty of maintaining and building up herds of antelope is in striking contrast with the ease attending the increase of herds of other game animals. Buffalo, elk, mule deer, and white-tailed deer appear to be as hardy and to breed as freely on game refuges as ordinary domestic stock. They are at the same time surprisingly free from diseases.

No damage by fire was done to any of the refuges during the year.

The following table shows the number of big-game animals on the refuges under the jurisdiction of this bureau at the close of each calendar year from 1916 to date, the figures for 1923 being as reported up to June 30 only:

Kind of game.	1916	1917	1918	1919	1920	1921	1922	1923
Buffalo	206	251	311	381	431	508	603	717
Elk	165	205	261	345	433	519	[a] 608	[a] 657
Antelope	47	57	55	54	65	91	21	16
Deer, mule	2	2	15	21	27	54	[a] 52	[a] 62
Deer, white-tailed	3	6	8	9	5	21	[a] 31	[a] 27
Mountain sheep							15	[a] 20
Total	423	521	650	810	961	1,193	1,330	1,499

[a] Estimated.

The distribution of the 1,499 big-game animals shown in the last column above on reservations under the jurisdiction of the Biological Survey was as follows:

Kind of game.	Bison Range.	Wind Cave.	Niobrara.	Sullys Hill.
Buffalo	549	107	48	13
Elk	[1] 400	[1] 170	57	30
Antelope		16		
Deer, mule	[1] 60	2		
Deer, white-tailed	[1] 20		2	5
Mountain sheep	[1] 20			
Total	1,049	295	107	48

[1] Estimated.

National Bison Range, Mont.—By far the most disastrous occurrence in connection with this refuge was the final extermination of the remnants of the herd of 60 antelope that was on this range early the preceding year. The antelope were killed by predatory animals which came in from the surrounding country during severe winter weather, probably assisted by Indian dogs from the reservation near by. During several years hunters have been detailed to destroy predatory animals in and about this and the other game refuges, and large numbers have been thus killed. The destruction of antelope here and at Wind Cave is good evidence of the difficulty of protecting game refuges from the inroads of coyotes or other predatory animals, which are able to travel great distances during a single night. Antelope appear to be peculiarly helpless before such danger, the losses of other game animals from this source in the same refuge being negligible.

The rapid increase of buffalo and elk on this range has about stocked it to capacity, as is shown by indications of deterioration in the range here and there. As a consequence, it has become necessary to provide for the disposal of surplus animals. Negotiations looking to this were initiated during the last part of the year.

The buffalo on the preserve now number 549, including 92 calves of the year. Only three deaths took place in the herd during the year. It is estimated that there are about 400 elk in the herd, including about 60 of this year's calves. So far as known, only two elk, both young bulls, died during the year. The mule deer, white-tailed deer, and mountain sheep are all doing well. It is estimated that from 50 to 60 beavers live along Mission Creek within the reservation.

The number of game birds on the refuge is estimated to include about 400 sharp-tailed grouse, 50 blue grouse, 50 Hungarian partridges, 100 Chinese pheasants, and 200 mallard ducks. During mild weather in the last part of February 12 Chinese pheasants in excellent condition and apparently preparing to mate appeared about the headquarters corral. These introduced birds appear to have become well established on the refuge, and with other game birds will serve to supply a surplus to sportsmen in the country surrounding the fenced area.

A number of needed improvements were added during the year, including a reservoir 130 feet long, 30 feet wide, and 4 feet deep; a frame cabin, known as "The substation"; an ice house; four small outbuildings; and three poison and trapping stations for predatory animals. Many old posts in the game fence were replaced or reset, and two floodgates crossing Mission Creek were rebuilt to prevent the animals from escaping.

Wind Cave Game Preserve, S. Dak.—Coyotes had reduced the antelope herd on this refuge by early spring from 21 to 8 does. By June 30 these were accompanied by an equal number of fawns, making a total of 16. In order to protect them a number of poison-bait stations were established and a vigorous campaign was put in effect and will be continued to destroy the predatory animals in and about the refuge. As in the case of the Bison Range, the surrounding country is inhabited by coyotes and other game-killing animals, which frequently travel great distances. Consequently it will be possible to maintain antelope here only with unceasing vigi-

lance. The buffalo and elk are in excellent condition and have increased to a point that necessitates the disposal of a number of each in order to prevent the range from becoming overstocked.

Evidence of the unexpected aggressiveness of bobcats on the game was found when a warden trailing an antelope during a winter snowstorm discovered that a bobcat had joined the trail a little ahead of him. A short time later he came on the carcass of a full-grown antelope that had been killed by the cat just before the warden arrived. A large number of coyotes have been destroyed in and about this refuge.

Niobrara Reservation, Valentine, Nebr.—The large game animals on this refuge up to the end of the present year have been maintained in two small inclosures. Several years ago the inclosure of an additional 4,000 acres of excellent range land for game was undertaken and was completed at the end of the present year. Later in the season game will be transferred to it. A number of beavers live along the river on this refuge, but how many is not known.

Quail were more numerous here during the spring of 1923 than at any other time within the past seven years. About 300 pairs of prairie chickens and sharp-tailed grouse nest along the southern side of the refuge, and in winter others move into the shelter from the more open country on the north side. Many ducks remain along the river on the refuge during winter, when at times several hundred are present.

Sullys Hill Game Preserve, near Devils Lake, N. Dak.—The hostess house for visitors to this refuge and 1 mile of 6-foot fence which keeps the buffalo and elk from Sweetwater Lake, were completed, thus making the refuge a pleasanter place for the public to visit. This refuge continues to be a popular place for picnic outings for people of Devils Lake and the surrounding region, the total number of visitors during the fiscal year being 6,079, as follows: July (1922), 2,931; August, 1,321; September, 514; June (1923), 1,313.

The numbers of animals on the refuge on June 30 were as follows: Buffalo, 13; elk, 30; white-tailed deer, 5; a total of 48. Shipping corrals were built for the purpose of readily crating and transporting surplus elk. Unfortunately, severe weather conditions developed before shipments could be made, and a number of the elk perished. The buffalo came through the winter in excellent shape.

Winter Elk Refuge, Jackson, Wyo.—The early winter was comparatively open, with light snowfall, thus leaving the pasturage accessible to the game. About 3,400 elk were fed on the two feeding grounds, of which 3,000 or more came in early in the year and about 400 came in in small parties at different times. They remained in good condition throughout the season and the loss was comparatively light.

Feeding the elk started on January 23, after a snowfall of 21 inches, and continued until April 25. Very satisfactory results were obtained by the construction of feeding corrals for the elk calves, so arranged with low, narrow entrances, called "creeps," that the calves could enter to feed free from molestation by the larger animals. This method of feeding was so successful that it will be continued on an extended scale during the coming winter. It is certain that this will result in saving a large number of calves that would have died, as

formerly, from being pushed about and worried by the large animals on the general feeding grounds.

At the commencement of winter the bureau had on hand a little less than 1,000 tons of hay, of which 686 were raised on the refuge, the remainder being purchased from neighboring ranches. In addition, the grazing privileges were rented on 400 acres of bottom lands. At the end of the season 85 tons of hay remained on hand.

In order that the refuge may be made to produce the maximum of hay a tractor with plows and other implements has been purchased and an increased annual acreage will be tilled until the entire range is producing.

Much of the fencing about this refuge is now old and in such condition that it must be replaced in the near future. Other improvements are also greatly needed.

BIRD REFUGES.

Flat Creek Bird Refuge, Wyo., covering 40 acres in the valley bottom adjacent to the winter Elk Refuge at Jackson, was established by Executive order of September 29, 1922. Although this is a small area it is used extensively by migratory wild fowl not only during the nesting period and migrations but also throughout the winter months. The area contains springs which keep it open throughout the winter and afford plant and insect food which sustain the resident ducks during the cold season. Its situation adjacent to the Elk Refuge adds additional pasture for the elk herds.

Belle Fourche Bird Refuge, S. Dak.—Conditions on this refuge were, as formerly, unsatisfactory, owing to the continuous grazing on lands immediately adjacent to the lake shore, without which nesting birds might take advantage of the cover. Fencing has been built for the purpose of eliminating livestock from this portion of the refuge. The excellent result from this has become apparent and it is planned to increase the protected area in order to attract additional nesting birds.

Big Lake Bird Refuge, Ark.—This refuge is notable as a resting and feeding place for wild fowl during both spring and fall migrations. Through the excellent support given the wardens by the District Court of the Eastern District of Arkansas in the protection of this refuge the people of the region now respect it and look upon it as a distinct local asset. A warden's house has been built on the highest point of the refuge near the principal hunting and trapping grounds, and is an improvement which renders the control of the lake much more effective. In order to prevent undue disturbance of the wild fowl, trapping of fur-bearing animals on this refuge is allowed only under permit, the trappers not being permitted to visit their traps before sunrise or after sunset. Refuges of this character are exceedingly important in giving migratory wild fowl resting places during their journeys north and south. With the drainage of many other water areas such places are becoming more and more valuable for the purpose for which created.

Lake Malheur Bird Refuge, Oreg.—A compromise agreement proposed by representatives of the State of Oregon and of the Biological Survey as to the future status of this refuge was not consummated, and the matter still remains for adjustment. Ravens are so abundant

in this district that they are becoming a menace to the welfare of the wild fowl breeding there and must be reduced in numbers. Serious depredations by them on the bird life, particularly during the breeding season, call for active measures against them, and these will be taken during the coming winter.

Salt River Bird Refuge, Roosevelt, Ariz.—On August 8, 1922, the Secretary of Agriculture issued an order permitting the hunting of migratory wild fowl on the eastern arm of Roosevelt Lake within this refuge. This will give a limited amount of hunting in a region where opportunities for this sport are exceedingly scarce, but will not seriously interfere with the welfare of the birds.

MIGRATORY-BIRD TREATY AND LACEY ACTS.

The helpful effect of the migratory-bird treaty act in increasing the supply of migratory wild fowl continues to impress all observers and to make friends for this legislation from its former opponents. Unfortunately, the progress of drainage of fresh-water marshes and lakes goes on rapidly, and unless enough of these areas can be perpetuated to afford feeding and breeding grounds no hope can be held out for the maintenance of the supply of these fine game birds. During the year representatives of the bureau have assisted State game commissions and other conservationists to protect several fine wild-fowl water areas from drainage, notably Swan Lake in Minnesota and the Winneshiek Bottoms on the upper Mississippi.

COOPERATION.

The Biological Survey is deeply indebted to State game officials, conservation organizations, and sportsmen from practically every State for the fine spirit of cooperation extended by them, not only in the enforcement of the law but in influencing public opinion for its observance. Much effort has been made to build up and maintain this cooperation, to which so much of the success achieved in increasing our migratory wild fowl is directly attributable.

WARDEN SERVICE.

Approximately 28 full-time United States game wardens were on duty through the year, aided by about 400 cooperative deputy wardens. Of the last, 35 were placed on per diem duty during short intervals in emergencies. Cooperative wardens receive a nominal salary of $1 per annum, except when placed on active duty, when they receive $3.50 a day with an allowance for expenses.

Shortly after he entered the service and while in the performance of his duty, United States Game Warden Edgar A. Lindgren, of Council Bluffs, Iowa, was brutally murdered by two Italians on August 13, 1922. A United States attorney assisted the State authorities in the prosecution of the assassins, who were convicted in the State court and sentenced to life imprisonment. Several other Federal game wardens also were feloniously assaulted while in the discharge of their duties, one with a loaded firearm, but fortunately they were not seriously injured. The frequent occurrence of these assaults on Federal wardens again demonstrates the great need of a

Federal statute under which assailants of Federal officers engaged in the discharge of their duties may be adequately punished.

STATE HUNTING LICENSES.

Incomplete returns show a substantial increase in the number of hunting licenses issued in some States and a small decrease in others. Reports received indicate that the total number issued in the United States probably exceeds 4,000,000, approximately the same number as issued the preceding year. In addition, under a legal authorization, nearly half as many people hunted without a license.

MIGRATORY-BIRD TREATY-ACT ADVISORY BOARD.

The migratory-bird treaty-act advisory board held its annual meeting in Washington on December 14 with 16 of the 22 members present. A number of amendments to the Federal regulations suggested by the bureau were considered by the board, and its recommendations were very helpful to the department in reaching its decisions on the advisability of making changes in the regulations. The meeting of this board each year is of great service to the bureau also in giving an opportunity to confer with State game officials and other conservationists among its members regarding migratory wildfowl conditions throughout the country and the effect of the policy of the department in maintaining the supply of these valuable game birds.

MATING HABITS OF MIGRATORY WATERFOWL.

Supplementing its investigations of last year to determine the earliest mating dates of wild ducks in the Mississippi Valley regions, the bureau this year again assigned an assistant biologist to investigate mating and breeding habits of wild fowl in Missouri, as stated earlier in this report. Last year his investigations were confined mainly to the northern part of the State, but this year they extended into the southeastern sections, where the mating of wild ducks was found to be well advanced as early as February 21. The data thus gathered are of the utmost value, in view of the demand still being made for the privilege of hunting wild fowl in Missouri and certain other States later in the winter than January 31.

PERMITS TO KILL MIGRATORY BIRDS INJURIOUS TO PROPERTY.

Under regulation 10 of the migratory-bird treaty-act regulations the Secretary issued orders during the year permitting employees of the State Conservation Commission of Wisconsin to kill great blue herons and authorizing State game wardens of Idaho to kill mergansers and great blue herons when these birds are found injurious to fish. In addition, growers of small fruits in Connecticut, Idaho, and Washington and members of their immediate families and their bona fide employees were given permission to kill robins found injuring cherries or other small fruits from May 16 to September 30. Permits for this purpose were already valid in Colorado, Indiana, Minnesota, New Hampshire, New York, Oregon, and Wisconsin. These orders provide that robins may be killed only when committing or about to commit serious injury to growing cherries or

other small fruits, and only by the holders of permits countersigned by the chief official in charge of the enforcement of the fish and game laws of the State in which the order is effective. Permits are revocable in the discretion of the Chief of the Bureau of Biological Survey or of the person countersigning them.

VIOLATIONS OF THE MIGRATORY-BIRD TREATY ACT.

At the beginning of the fiscal year, migratory-bird treaty-act cases to the number of 722 were pending before the courts, and during the year there were 693 new cases reported for prosecution. Of these 1,415 cases, 472 were disposed of by convictions, 28 were nolle prossed, in 2 the grand jury did not return true bills, 99 were dismissed, 3 were terminated by the death of the accused, and in 8 the jury returned a verdict of not guilty; the remainder are pending.

The total revenue collected during the year in all cases amounted to about $8,650, the fines ranging from $250 to $1 each. In numerous instances the defendants were also required to pay the costs, which in some cases equaled and in others exceeded the amount of the fines. About 115 other cases were reported by the Federal wardens, which, on account of the youthfulness of the accused, insufficient evidence, adequate fines having been imposed previously in State court, or for various other reasons, were not forwarded for Federal prosecution. The evidence in many of the cases, however, was transmitted to State game authorities for appropriate action, as violations of State laws were involved.

Convictions in Federal courts were distributed as follows: Alabama, 20; Arkansas, 15; Delaware, 13; District of Columbia, 2; Florida, 19; Georgia, 55; Idaho, 3; Illinois, 51; Indiana, 29; Iowa, 20; Kansas, 9; Kentucky, 3; Louisiana, 13; Maine, 14; Maryland, 12; Massachusetts, 13; Minnesota, 18; Mississippi, 7; Missouri, 19; Montana, 7; Nebraska, 6; Nevada, 3; New Mexico, 3; North Carolina, 4; Ohio, 14; Oklahoma, 2; Oregon, 14; Pennsylvania, 1; South Carolina, 5; South Dakota, 5; Tennessee, 14; Texas, 21; Virginia, 23; Washington, 13; West Virginia, 1; and Wisconsin, 1.

Four jail sentences, ranging from 5 months to 15 days each, were imposed against violators in Maryland and Nebraska as a result of illegal trapping, sale, and shipment of wild ducks, killing ducks in close season, and hunting ducks after sunset. While many substantial penalties were imposed, some offenders escaped with small fines and a few on payment of costs.

Fines ranging from $100 to $25 were imposed against many offenders for offering for sale and selling aigrettes, possessing ducks in storage during the close season, selling ducks, hunting ducks from motor boats, capturing live waterfowl, and operating without a Federal permit, and for other miscellaneous offenses. The fourth and fifth convictions for the hunting of wild fowl from an airplane were obtained in the Federal Court for the Eastern District of Arkansas on May 8, 1923, where the violators, charged with killing wild ducks from an airplane, were fined $20 each. Six cases involving this means of hunting are still pending.

Among other cases of interest terminated during the year may be mentioned 2 in South Carolina, involving the killing of wood ducks and resulting in a fine of $250 each; 1 in the District of Columbia,

where wild ducks were possessed in cold storage during the close season and a fine of $250 was imposed; 1 in Ohio, involving the hunting of ducks in close season, in which a fine of $125 and costs was assessed; and 1 in Missouri, involving the killing of wood ducks and resulting in a fine of $150.

SCIENTIFIC-COLLECTING AND OTHER PERMITS.

During the year 994 permits were issued authorizing the collecting of migratory birds or their nests or eggs for scientific purposes. This is an increase of 42 permits over the previous fiscal year. About half the permits issued were limited in character, confining the operations of the permittees to the collection of nongame birds and of shorebirds during the open season for black-breasted and golden plovers and greater and lesser yellowlegs. Permits authorizing the possession, purchase, sale, and transportation for scientific purposes of migratory birds legally acquired, but not the collection of such birds, were issued to 201 persons, most of whom were taxidermists.

Permits authorizing the possession and sale of migratory waterfowl raised in captivity were issued to 3,538 persons, and permits authorizing the taking of a limited number of waterfowl or their eggs for propagating purposes were issued to 90.

The bureau issued permits authorizing the trapping of migratory birds alive for banding purposes to 847 persons, an increase over the fiscal year ended June 30, 1922, of 357. These permits are issued by the bureau in line with its investigations relative to the times and lines of flight of migratory birds. The holder of a bird-banding permit is allowed to possess a migratory bird only a sufficient length of time for it to be properly banded and liberated.

INTERSTATE COMMERCE IN GAME.

The number of cases reported for prosecution under the Lacey Act has decreased steadily since the passage of the migratory-bird treaty act. This is due partly to the fact that the illegal interstate transportation of all wild birds now is a Federal offense under section 4 of the migratory-bird treaty act, and partly to the fact that wild animals or parts thereof are more frequently transported in interstate commerce by means other than common carrier, thus avoiding the Federal statute, although transported in violation of State laws. The bureau, through its game-warden service, has been able to render valuable cooperation in various States by unearthing shipments involving interstate commerce in birds and animals made in violation of State laws, and by collecting and reporting the evidence to State game authorities. Many States have collected thousands of dollars through fines resulting from evidence obtained by Federal wardens. Furthermore, these Federal laws have a most salutary effect in safeguarding wild life, as persons prone to violate State laws know that the valuable assistance rendered the States by United States game wardens materially lessens the chance of a violator escaping the jurisdiction of either Federal or State courts.

Evidence of approximately 200 apparent violations of State laws was turned over to State game officials during the year, and 145 State prosecutions based on information furnished by the bureau,

or in which the bureau assisted in completing the evidence, were brought to successful conclusions in State courts with fines, costs, and forfeitures totaling more than $7,000. Many guns and traps, the carcasses of 2 deer, and the skins of 27 muskrats and 66 beavers were included in the list of articles confiscated in connection with the disposition of these State cases. In an Oregon case one violator was fined $300 and sentenced to 30 days in jail.

Of six cases reported for Federal prosecution during the year, two, together with five cases previously reported, were disposed of in Federal courts. Of these seven cases, four resulted in the imposition of fines and costs totaling $250; two prosecutions were barred by the statute of limitations, because informations were not filed in time; and one was dismissed because the authorities were unable to apprehend the accused.

Many other investigations of interstate shipments were made, but did not result in prosecutions, as the shipments were either legally made or it was impossible to obtain evidence of their illegality. At the close of the fiscal year 85 cases were being investigated.

IMPORTATION OF FOREIGN BIRDS AND MAMMALS. 1923

The importation of foreign birds and mammals, while showing a considerable increase over that of previous years, has not yet reached the maximum prior to the World War, which was attained in the year 1913. The number of permits issued during the year was 572, an increase of 44 over the previous year, and the number of shipments inspected increased from 186 to 222. The total number of birds imported was 388,388, of which 8,331 were entered without permits.

The permits for mammal imports included 2,756 foxes from Canada, a considerable increase over the 2,064 authorized to enter in 1922. One notable importation of mammals was a shipment of 12 chinchillas, which reached Los Angeles, Calif., about February 20. This is the first consignment of which there is any record for many years of these animals actually imported into the United States.

Importation of game birds included 9,123 Mexican quail, some ruffed grouse from Canada, a few Hungarian partridges, and occasional small consignments of ducks and geese, and 600 bamboo partridges and 200 sand grouse were received from China in January. Importations of some of the rarer aviary pheasants have decreased to such a very low point that very few of some species are to be found in the United States since the dispersal of several of the larger private collections of pheasants which were brought together 20 years ago.

The principal cage birds imported as usual have been canaries and parrots, of which the canaries numbered about 182,000 and the parrots 37,721. Of the latter group, those most commonly entered are Cuban parrots, several of the other Amazons from tropical America, and grass parrakeets from Australia. A shipment of 6,000 grass parrakeets entered on June 30, 1922, passed into the hands of three of the large importers in New York, and nearly all died within six months after arrival. These were wild birds, and when cold weather came on and the windows were closed in the buildings in which they

were confined they seemed to have contracted some disease from other birds, and practically all of them were reported to have died within a few weeks. Of the popular Lady Gould finches, 816 arrived in one shipment. Of the weaver birds, 600 black-headed nuns were entered in one consignment, and about 200 in all of the rufous-necked weaver birds were brought in, about half of which arrived in one day in January.

A marked decrease in the importation of some of the common European and Asiatic birds was evident in the small number of entries of skylarks, brown linnets, chaffinches, and nightingales, as well as such of the cheaper oriental birds as Java sparrows, strawberry finches, nutmeg finches, sociable finches, diamond finches, and tricolored nuns.

A number of rare and interesting birds were included in the importations from the Old World, particularly from Africa, the Orient, and the East Indies. Among these may be mentioned two eagle owls (*Bubo bubo*), from Europe; two species of ground hornbills (*Bucorvus abyssinicus* and *B. caffer*), the red-collared wydah (*Penthetria ardens*), and the rufous-tailed wydah (*Bathilda ruficauda*), from Africa; the golden-headed mynah (*Ampeliceps coronatus*) and knobbed geese (*Cygnopsis cygnoides*), from India; 8 fire-back pheasants (*Lophura diardi*), from Siam; several species of pigeons from the East Indies and South Pacific, including 2 bronze-winged partridge pigeons (*Geophaps smithi*) from northwestern Australia, 30 *Phlogoenas rubescens* from the Marquesas Islands, 2 yellow-breasted fruit pigeons (*Leucotreron occipitalis*) from the Philippines, one nutmeg pigeon (*Myristicivora bicolor*) from the East Indies, and 12 bleeding-heart doves (*Phlogoenas luzonica*) from the Philippine Islands. The Marquesas Islands pigeons apparently represented the first importation of this species into the United States, and the bleeding-heart doves were the first that had been received from the Philippines for some time, although before the war considerable numbers of these interesting birds were entered at Pacific coast ports.

An attempt has been made to coordinate efforts by zoological gardens and museums to obtain some of the rarer birds. Several years ago an anomalous condition existed under which certain birds which were entirely unrepresented, or very poorly represented, in some of the largest public museums in this country were exhibited alive in several zoological gardens, while the museums failed to realize for some time the opportunity of obtaining desirable material in case the birds died. Two notable examples are those of the golden-headed mynah of India (*Ampeliceps coronatus*) and a handsome African weaver bird (*Hyphantornis cucullatus*), which until recently were represented in the United States National Museum by one or two specimens, and yet 18 of the mynahs and more than 200 of the weaver birds were imported alive during the year. This condition has been partially remedied by checking up the lists of desiderata of some of the larger museums, so that it is now possible to tell whether or not imported birds are represented in museum collections as well as in zoological gardens.

Many inquiries are received from time to time in regard to the importation of foreign game birds which may be useful for stocking covers or increasing the local game supply. Unfortunately, it can not be said that importations of game birds since the war have done

very much for the improvement of existing conditions. Mexican quail, which have been imported in considerable numbers, have been distributed for the most part in only four or five States, and the rest of the country has received little benefit from these importations. A few ruffed grouse have been imported from Alberta, but in such small numbers as to provide breeding stock for only a few localities. Pheasants have been conspicuous by their absence, but this may indicate that the main demand for ring-neck pheasants is now supplied by stock bred in this country. A few Hungarian partridges have been brought in, but high prices at present prohibit restocking with these birds on a large scale.

The demand for new birds can not be met properly until there is closer cooperation between aviculturists, experimenters, and game commissions in order to ascertain the precise conditions under which certain species may be acclimated and the peculiar treatment required by each. Among the more promising game birds are the Prince of Wales and true Mongolian pheasants, tinamous of several species from South America, the chuckar partridge from India, the bamboo partridge from China, the red-legged partridge, and the black cock of Europe. Spasmodic attempts have been made from time to time to introduce these birds into the United States, but sustained experiments under favorable conditions have not been continued long enough to ascertain the reason for lack of success.

IMPORTATION OF QUAIL FROM MEXICO.

Comparatively few quail were imported from Mexico during the past spring, notwithstanding the extensive preparations made by several importers. The first shipment of 72 birds was entered at Brownsville, Tex., on January 3, but, by common consent, dealers postponed operations until February so that the birds would not arrive in the north during cold weather. Shipments did not begin regularly until February 15, but during the next month they arrived at frequent intervals at the ports of Brownsville and Laredo, Tex. No birds were entered at Eagle Pass, Tex.

Owing to restrictions imposed by Mexican authorities comparatively few large shipments were brought in, most of the birds being entered in consignments of 500 or less. About 6,500 were forwarded to the Kentucky game and fish commission, some were shipped to the conservation commission of Maryland, and others were distributed to various other States. No quail disease appeared, and shipments were admitted to entry without being held in quarantine, but were examined as usual by inspectors of the Bureau of Animal Industry. Importations reached their maximum early in March, but fell off noticeably toward the latter part of the month.

The total number of quail imported during the season was 9,123, which makes the total number of Mexican quail entered during the 13 years since importations began 161,471.

PUBLICATIONS ISSUED FROM THE BUREAU DURING THE YEAR.

NORTH AMERICAN FAUNA.

No.

46. A Biological Survey of the Pribilof Islands, Alaska: Part I, Birds and Mammals; Part II, Insects, Arachnids, and Chilopods. Pp. 255, pls. 15 (including 3 maps).

No.

DEPARTMENT BULLETINS.

1078. Beaver Habits, Beaver Control, and Possibilities in Beaver Farming. Pp. 31, pls. 7, figs. 7 (including map).
1089. Reindeer in Alaska. Pp. 74, pls. 24, figs. 2 (including map).
1091. Life History of the Kangaroo Rat, *Dipodomys spectabilis spectabilis* Merriam. Pp. 40, pls. 9, figs. 3 (including map).
1145. Migration Records from Birds Banded at Great Salt Lake, Utah. Pp. 16, pls. 2, fig. 1 (map).
1151. Silver Fox Farming. Pp. 60, pls. 4, figs. 46 (including map).

FARMERS' BULLETINS.

1288. Game Laws for 1922. Pp. 80.
1293. Laws Relating to Fur Animals, 1922. Pp. 30.
1302. How to Get Rid of Rats. Pp. 14, figs. 8.
1327. Canaries: Their Care and Management. Pp. 22, figs. 6.

REVISED EDITIONS.

506. Food of some Well-known Birds of Forest, Farm, and Garden. Pp. 34, figs. 16.
587. Economic Value of North American Skunks. Pp. 24, figs. 10.
621. How to Attract Birds in the Northeastern States. Pp. 16, figs. 11.
702. Cottontail Rabbits in Relation to Trees and Farm Crops. Pp. 14, figs. 4.
844. How to Attract Birds in the Middle Atlantic States. Pp. 16, figs. 11.
869. The Muskrat as a Fur Bearer, with Notes on Its Use as Food. Pp. 20, figs. 4.
1239. Community Bird Refuges. Pp. 16, figs. 3.
1247. American Moles as Agricultural Pests and as Fur Producers. Pp. 24, figs. 16.

DEPARTMENT CIRCULARS.

242. Directory of Officials and Organizations Concerned with the Protection of Birds and Game, 1922. Pp. 20.
260. Report of the Governor of Alaska on the Alaska Game Law, 1922. Pp. 7.
261. Bird Censuses and How to Take Them. Pp. 4.

SERVICE AND REGULATORY ANNOUNCEMENTS (BIOLOGICAL SURVEY).

47. Hunting of Wild Fowl on Salt River Reservation, Ariz. P. 1.
48. Migratory Bird Treaty Act and Regulations. (Including amendments of March 8, 1922.) Pp. 12.
49. Importation of Quail from Northeastern Mexico. P. 1.
50. Trapping of Fur-bearing Animals on Big Lake Reservation, in the State of Arkansas. P. 1.
51. Regulations for the Protection of Land Fur-bearing Animals in Alaska. P. 1.
52. Regulations for the Protection of Land Fur-bearing Animals in Alaska. P. 1.
53. Regulations for the Protection of Game in Certain Localities in Alaska. Pp. 3.
54. Regulations for the Importation of Eggs of Game Birds for Propagation. Pp. 2.

PUBLICATIONS IN PRESS AT CLOSE OF YEAR, WITH MANUSCRIPT TITLES.

Report on Bird Censuses in the United States, 1916 to 1920. (Department Bulletin No. 1165, pp. 36, fig. 1, map.)
Food and Economic Relations of North American Grebes. (Department Bulletin No. 1196.)
Local Names of Migratory Game Birds. (Miscellaneous Circular No. 13, pp. 95, figs. 52.)
Migratory Bird Treaty, Act, and Regulations. (Including amendments of June 11, 1923.) (Service and Regulatory Announcements—B. S. 55, pp. 13.)
Bird Houses and How to Build Them. (Revision of Farmers' Bulletin No. 609.)
Some Common Birds Useful to the Farmer. (Revision of Farmers' Bulletin No. 630.)
Common Birds of Southeastern United States in Relation to Agriculture. (Revision of Farmers' Bulletin No. 755.)

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